

*National Park Service
Inventory and Monitoring Program*

**Review of Monitoring Programs for Vertebrates
of the
Northeast Coastal and Barrier Network**



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Introduction to the NPS Monitoring Program

Knowing the condition of natural resources in national parks is fundamental to the Service's ability to protect and manage parks. National Park managers across the country are confronted with increasingly complex and challenging issues, and managers are increasingly being asked to provide scientifically-credible data to defend management actions. Many of the threats to park resources, such as invasive species and air and water pollution, come from outside of the park boundaries, requiring an ecosystem approach to understand and manage the park's natural resources.

A long-term ecosystem monitoring program is necessary to enable managers to make better informed management decisions, to provide early warning of abnormal conditions in time to develop effective mitigation measures, to convince other agencies and individuals to make decisions benefiting parks, to satisfy certain legal mandates, and to provide reference data for relatively pristine sites for comparison with data collected outside of parks by other agencies.

The overall purpose of monitoring is to develop broadly-based, scientifically sound information on the current status and long term trends in the composition, structure, and function of the park ecosystem. Use of monitoring information will increase confidence in manager's decisions and improve their ability to manage park resources.

Legislation and Policy

National Park Service policy and recent legislation (National Parks Omnibus Management Act of 1998) requires that park managers know the condition of natural resources under their stewardship and monitor long-term trends in those resources in order to fulfill the NPS mission of conserving parks unimpaired. The following laws and management policies provide the mandate for inventorying and monitoring in national parks:

The mission of the National Park Service is "*...to promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purposes of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations*" (National Park Service Organic Act, 1916).

"The Secretary shall undertake a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources. The monitoring program shall be developed in cooperation with other Federal monitoring and information collection efforts to ensure a cost-effective approach" (National Parks Omnibus Management Act of 1998)

"The National Park Service will assemble baseline inventory data describing the natural resources under its stewardship and will monitor those resources at regular intervals to detect or predict changes. The resulting information will be analyzed to detect changes that may require intervention and to provide reference points for comparison with other, more altered environments" (NPS Management Policies, Chapter 4:4, 1988).

"The National Park Service will manage the natural resources of the national park system to maintain, rehabilitate, and perpetuate their inherent integrity" (NPS Management Policies).

"Naturally evolving plant and animal populations, and the human influences on them, will be monitored to detect any significant unnatural changes. Action will be taken in the case of such changes based on the type and extent of change and the appropriate management policy" (NPS Management Policies).

The National Environmental Policy Act of 1969 requires certain knowledge of resource conditions to direct and evaluate effects of management actions.

The Forest and Rangeland Renewable Resources Planning Acts of 1974 and 1976 also express Congressional insistence on inventory and monitoring of natural resources on all public lands in the U.S.

Several other Federal laws and executive orders also provide legal direction and support for expending funds to determine the condition of natural resources in parks (e.g., Endangered Species Act 1973, amended 1982; Fish and Wildlife Coordination Acts, 1958 and 1980; Migratory Bird Treaty Act, 1974; Clean Water Act; Executive Order 11900 (Protection of Wetlands); and the Clean Air Act.

Characteristics of Successful Long-term Monitoring Programs

For park managers to effectively try to maintain the biological diversity and ecological health of their parks, they must have a basic knowledge of what natural resources exist in parks as well as an understanding of those factors that may threaten them. One of the first goals of the I&M program is to establish baseline biological inventories for vascular plant and vertebrate species in order to provide reliable species lists, a fundamental tool for management. The program will also begin to gather relative abundance and distribution information for species of special concern. Detailed information on exotic invasive plant species for example, as well as on rare and threatened species can enable more effective management practices. The simple knowledge of what and where species exist in the parks is crucial in making decisions on such things as building new trails, buildings and restoring cultural landscapes. Phase II of the I&M program will involve developing long-term monitoring programs to efficiently and effectively monitor ecosystem status and trends over time within the parks.

In order to reduce costs and increase efficiency, the National Park Service has clustered parks into I&M Program "Networks" so that data acquisition might occur simultaneously at several

locations. The basic data themes that have been identified for the Phase I natural resource inventory represent the recommended minimal data set for all natural resource parks. These data theme descriptions can be found in the Inventory and Monitoring Guidelines for Biological Inventories (National Park Service, 1999).

Priority biota groups include:

vascular plants

vertebrates

Federally and state listed threatened and endangered species

species of special concern within the park, including endemic, nonnative, and other species identified by legislation.

Selecting Indicators - What Should be Monitored?

The selection of the best indicators for monitoring the park's ecosystems is one of the most difficult steps in designing a long-term monitoring program. It is impossible, and unnecessary, to sample all natural resources and ecosystem processes in a park, so how does one select indicators from the long list of candidates?

The largest, most expensive, and probably most scrutinized environmental monitoring program to date has been the EPA's EMAP (Environmental Monitoring and Assessment Program). The goal of EMAP is very similar to that of national parks: *"To monitor the condition of the Nation's ecological resources to evaluate the cumulative success of current policies and programs and to identify emerging problems before they become widespread or irreversible."* The EPA, U.S. Forest Service, and other agencies have spent many millions of dollars developing and testing various indicators for monitoring ecosystems, and still there is little consensus on which indicators are best or how best to quantify them.

Noon et al. (1999) clarified some of the terminology used in environmental monitoring as he described what an indicator is: *"An attribute is simply some aspect of the environment which is measurable. When an attribute is measured it takes on a (usually) numeric value. Since the exact value of an attribute is seldom known with certainty, and may change through time, it is properly considered a variable. If the value of this attribute is indicative of environmental conditions that extend beyond its own measurement, it can be considered an indicator. Not all indicators are equally informative -- one of the key challenges to a monitoring program is to select for measurement those attributes whose values (or trends) best reflect the status and dynamics of the larger system."*

In their review of EPA's EMAP program, the National Research Council (NRC 1995) discussed the relative merits of retrospective monitoring, EMAP's basic monitoring approach, versus predictive or stressor-oriented monitoring. Retrospective, or effects-oriented, monitoring, seeks to find effects by detecting changes in the status or condition of some organism, population, or community. This includes most of the monitoring in national parks, such as measuring changes in foliage condition of trees, size or trends in animal populations, or diversity of aquatic macroinvertebrates in streams, and it takes advantage of the fact that biological indicators

integrate conditions over time. In contrast, predictive, or stressor-oriented monitoring seeks to detect the cause of an undesirable effect (a stressor) before the effect occurs or becomes serious. Stressor-oriented monitoring will increase the probability of detecting meaningful ecological changes, but it is necessary to know the cause-effect relationship so that if the cause can be detected early, the effect can be predicted before it occurs. Examples of predictive monitoring include monitoring animal tissues for presence of carcinogens, and using a canary to monitor toxic gas levels in a mine. Predictive monitoring is not commonly used in national parks because our knowledge of ecosystem processes is still poor and cause-effect relationships have often not been established. The NRC concluded that in cases where the cost of failing to detect an effect early is high, use of predictive monitoring and modeling is preferred over retrospective monitoring. They concluded that traditional retrospective monitoring was inappropriate for environmental threats such as acid precipitation, exotic species effects, ozone depletion, and biological extinctions, because of the large time lag required for mitigation, and recommended that EPA investigate new indicators for monitoring these threats.

Many different criteria have been recommended for selecting indicators to monitor park resources, and these are mentioned in the documents listed above. Another good set of indicator-selection criteria came out of an April 1998 workshop for Lake Mead National Recreation Area:

Desirable characteristics of indicators

- have dynamics that parallel those of the ecosystem or component of interest
- are sensitive enough to provide an early warning of change
- have low natural variability
- provide continuous assessment over a wide range of stress
- have dynamics that are easily attributed to either natural cycles or anthropogenic stressors
- are distributed over a wide geographical area and/or are very numerous
- are harvested, endemic, alien, species of special interest, or have protected status
- can be accurately and precisely estimated
- have costs of measurement that are not prohibitive
- have monitoring results that can be interpreted and explained
- are low impact to measure
- have measurable results that are repeatable with different personnel

Purpose of This Review

The purpose of this effort was to identify vertebrate monitoring programs conducted by both the National Park Service within the Coastal and Barrier Network parks as well as other agencies, including state, local and non-governmental organizations, in or in close proximity to the parks. The goal was to identify those species or groups of species existing in the Network parks that have been noted by scientifically based programs as “good indicators of ecosystem health”. \

By narrowing down the number of possible candidates for species monitoring in the Network, small working groups could be assembled by the Network Technical Steering Committee in the near future to discuss the need for development of a Network species monitoring plan. A Coastal and Barrier Coastal Network Scoping Workshop held in April 2000 did include a species workgroup, but after the workshop, participants felt that little was accomplished due to the lack of information readily available, including knowledge of existing species monitoring programs, and complete park species lists. This lack of information was the basis for this datamining project.

Several vertebrate monitoring programs being conducted within the Northeast and nationally were identified and a tremendous amount of data was obtained as a result of this effort. Some monitoring programs such as the Christmas Bird Counts and the Breeding Bird Survey have been conducted since the early 1900’s whereas some of the monitoring programs including some state and university programs were only conducted for a few years. As a general rule, a survey or inventory was considered a monitoring program if it had been conducted continuously for three or more years (i.e. Breeding Bird Survey) or repeated over a long period of time (i.e. Breeding Bird Atlas).

Obtaining data from each of these programs was extremely time consuming. The data was obtained in various forms from hardcopy lists and reports to extensive Excel files. The data was sometimes summarized such as The Long Island Waterbird and Piping Plover report with trends in populations discussed or years of raw data was obtained with no summarization.

Many of the monitoring programs identified were not intended to focus on a particular species or groups of species as “indicators of good ecosystem health”. However, the data obtained from these programs may assist taxa experts in understanding overall ecosystem health of the Coastal and Barrier Network parks by filling in informational gaps. Potential indicator species were discussed when possible based on available information. Gaps in data were also discussed when possible.

The results of this datamining effort and the associated data must now be thoroughly analyzed as to its usefulness to the NPS Inventory and Monitoring Program goals. This effort will need to

involve taxa experts who can identify data gaps in relation to a park's ecosystem health and then recommend indicator species and related monitoring programs.

All known inventories relating to each taxa group was listed. Most of this data was obtained through the National Park Service's NRBIB (listed on the website as of September, 2002) and the work of Scott Tiffney. These inventories include historic work that may be useful in identifying changes in species composition and abundance. Also note, inventories listed may not include recent and current inventories being conducted within the NPS that may not have been completed prior to Fall, 2002. Often, these inventories were mentioned in the monitoring programs section for each park.

In addition, species or taxa status within the park or along the Atlantic coast was discussed in relation to the most recent research identified. This information may assist taxa experts in identifying information gaps when used in conjunction with listed inventories and identified monitoring programs. This section gives brief overviews of species-habitat information for each park. A limited number of documents were used for these discussions and more thorough descriptions of species-habitat relationships may be available at each park or from the park biologists.

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Chapter I. Park Descriptions

The Coastal and Barrier Network consists of eight parks ranging in size from 83 to 48,000 acres and are located across four coastal states (Table 1). All of the parks in this network cover a wide range of habitat types from the salt marshes and sandy beaches of the Cape Cod National Seashore to the maritime holly forest of Fire Island National Seashore and barrier island habitats of Assateague Island National Seashore.

Table 1. Northeast Coastal and Barrier Network Parks

Park	State	Est.	Federal Acreage	NonFed. Acreage	Total Acres	HA
Assateague Island National Seashore (ASIS)	MD,VA	1965	17,866	21,867	39,732	16,086
Cape Cod National Seashore (CACO)	MA	1961	27,501	16,104	43,604	17,653
Gateway National Recreation Area (GATE)	NY, NJ		20,444	6,166	26,610	10,773
Fire Island National Seashore (FIIS)	NY	1981	6,241	13,338	19,580	7,927
Colonial National Historical Park (COLO)	VA	1930/36	9,274	75	9,350	3,785
George Washington Birth Place NM (GEWA)	VA	1930	550	000	550	223
Thomas Stone National Historical Site (THST)	MD	1978	322	6	328	130
Sagamore Hill National Historic Site (SAHI)	NY	1962/66	83	000	83	34

Assateague Island National Seashore (ASIS)

Berlin, MD and Chincoteague, VA
Visitation 1,891,992

Assateague Island is a barrier beach island situated along the Maryland/Virginia Atlantic coastline. It encompasses more than 39,000 acres, more than half of which is comprised of oceanic and estuarine waters surrounding the Island. Assateague Island consists of three major public areas. Approximately 26,00 acres of this island are located in Maryland. The state of Maryland manages a section of the northern part of the island called Assateague State Park and the NPS manages the remainder of the Maryland portion of the island as Assateague Island National Seashore (ASIS). The Virginia section of the island (13, 682 acres) is managed by the U.S. Fish and Wildlife Service as Chincoteague National Wildlife Refuge. The northern 10 km of ASIS called the "north end" is managed as a primitive area where public access is limited to foot and boat-in traffic. Vehicle traffic is restricted to NPS beach patrols and authorized research activities. The 3.2 km section of the island immediately south of Assateague State Park is

managed by ASIS as a developed recreational area and includes campgrounds, day-use facilities and interpretive trails. The 19 km section south of the developed area to the MD/VA state line is managed as a primitive and traditional recreation area, which permits off-road vehicle (ORV) use, back-country camping and hunting. Off-road vehicle use is restricted to the ocean beach and other designated trails west of the ocean beach.

The natural resources showcased by the park include a diverse assemblage of aquatic and terrestrial wildlife (including the free-roaming feral horses for which Assateague is famous), vegetation communities, and geological features and physical processes reflecting the complexity of the land/sea interface along the Mid-Atlantic coast. Habitats within ASIS include pristine barrier beach, freshwater impoundments, tidal salt marshes and upland deciduous and Loblolly pine forests. The indigenous plant communities reflect the adaptive extremes necessary for survival on a barrier island, where exposure to salt spray, lack of freshwater, and shifting sands create a harsh and dynamic environment. Throughout the Seashore, the relationship of land and water is paramount.

Changing patterns of land use in the watershed of the coastal lagoons of ASIS threatens park water quality and biotic systems. Although park waters are considered to be in “good” condition at present, nearby estuaries with more extensive development are significantly degraded, primarily due to eutrophication from anthropogenic nutrient inputs. With a projected growth rate of >20% over the next 25 years, the potential for similar degradation of park waters is considered high. The ability to document changing estuarine conditions, including trends in submerged aquatic vegetation, fish, and benthic invertebrate community composition, is considered crucial towards influencing and mitigating local/regional development.

Since 1935, the federal navigation channel at Ocean City, MD has disrupted the natural sediment supply to Assateague Island, resulting in wholesale physical and biological changes. A comprehensive mitigation program has been developed involving both short term (one-time beach nourishment) and long term components (sediment bypassing). Implementation and management of these programs will require the ability to continuously evaluate island conditions, (including changes in the distribution and abundance of rare species), relevant physical processes, and the effects of restoration actions in order to optimize outcomes and ensure maximum compatibility with management objectives.

Portions of ASIS provide suitable habitat for a variety of state and federally listed species, both plants and animals. The known and perceived threats to these species vary in intensity, and include a range of causative factors including recreational activities, disruptions to natural coastal processes, and interactions with both native and non-native species. Certain high-profile species such as the piping plover are being actively managed, but others remain poorly understood and are largely ignored. In particular, rare resident plant and insect species, and transient bird species lack appropriate levels of documentation (presence/absence, distribution and abundance) threat mitigation, and assessment.

Non-native plant (especially *Phragmites* and Asiatic sand sedge) and animal species (feral horses, sika deer, nutria) present on Assateague Island are known to be having a significant

impact on several of the primary vegetation communities occurring within ASIS. Documented effects include reduced health and reproductive capacity of certain key plant species, changes in species abundance and community composition, and loss of faunal biodiversity. The development of long-term management programs to mitigate the impacts of these species requires a variety of basic life history, distribution, and relative abundance data to guide decision-making and program implementation/evaluation.

The following list are some of ASIS's current management issues:

- **Altered coastal processes**-A federal navigation channel has disrupted sediment supply to Assateague Island, resulting in physical and biological changes. Implementation and management of current mitigation programs will require the ability to continuously evaluate island conditions, (including changes in the distribution and abundance of rare, threatened and endangered plant and animal species), relevant physical processes, and the effects of restoration actions to ensure compatibility with management objectives.
- **Exotic Species**-Non-native plant (especially Phragmites and Asiatic sand sedge) and animal species (feral horses, sika deer, nutria) are significantly impacting several primary vegetation communities including rare, threatened and endangered species occurring within ASIS. Documented effects include reduced health and reproductive capacity of certain key plant species, changes in species abundance and community composition, and loss of faunal biodiversity. Information regarding basic life history, distribution, and relative abundance of species is needed to guide decision-making and program implementation.
- **Visitor/Recreational Activity Impacts**-Issues include visitor impacts on rare, threatened and endangered plant and animal species; migratory shorebirds and ocean nearshore benthic macroinvertebrate communities.
- **Adjacent land use changes associated with estuarine water quality**-Changing patterns of adjacent land use threatens water quality and biotic systems within ASIS. Presently, ASIS waters are considered to be in "good" condition; however, nearby estuaries with more extensive development are significantly degraded due to nutrient enrichment from anthropogenic nutrient inputs. The potential for similar degradation of park waters is considered high. There is a need to routinely monitor living resources within ASIS estuarine habitats to detect potential community changes.
- **Rare, Threatened and Endangered Species**-Rare resident plant and insect species, and transient bird species lack appropriate levels of documentation (presence/absence, distribution and abundance), threat mitigation, and assessment.

Cape Cod National Seashore (CACO)

Wellfleet, MA
Visitation 4,915,414

Cape Cod National Seashore comprises 43,604 acres of shoreline and upland landscape features, including a forty-mile long stretch of pristine sandy beach, dozens of clear, deep, freshwater kettle ponds, and upland scenes that depict evidence of how people have used the land. A variety of historic structures are within the boundary of the Seashore, including lighthouses, a lifesaving

station, and numerous Cape Cod style houses. The Seashore offers six swimming beaches, eleven self-guiding nature trails, and a variety of picnic areas and scenic overlooks. Over 500 animal species inhabit the seashore, including migratory and resident birds, terrestrial and marine mammals, reptiles and amphibians, and salt- and freshwater fish as well as invertebrate species. CACO has 17 federal threatened or endangered animal species and 42 animal species that are listed as threatened, endangered or of special concern by the state of Massachusetts.

CACO is the prototype monitoring park for the Atlantic and Gulf Coast biogeographic region. The monitoring program is based on our best understanding of processes and component interactions governing the coastal ecosystem, and focuses on addressing management issues that confront coastal parks. An ecosystem-based, issues-oriented program is being developed to detect ecosystem changes, examine contributing factors and consequences of ecosystem changes, and to inform park management of the salient issues that such ecosystem changes represent. The goal of the program is to (1) detect changes in particular attributes of the coastal ecosystem and determine if those changes are within the bounds of natural or historic variability; (2) predict how those changes relate to natural processes and human influences; and (3) understand how such changes, ultimately, affect the condition of the coastal ecosystem. Monitoring data will provide a scientific basis for management decisions leading to effective protection and restoration of coastal ecosystems. Protocols are being developed to monitor estuarine nutrient enrichment, estuarine nekton (fish and decapod crustaceans), sediment and benthic fauna contaminants, shoreline change, water quality, groundwater hydrology, freshwater fish, aquatic invertebrates, amphibians, waterbirds, landbirds, white-tailed deer, and red foxes and coyotes. A report is available on the Conceptual Framework for development of monitoring protocols at Cape Cod NS.

CACO's current management issues include:

- **Aquatic/Estuarine Issues** include: cultural nutrient enrichment of Kettle Ponds and Salt Marsh, Historic Diking of Salt Marshes and need for restoration, Mosquitoes and Political Pressure for Mosquito Management, Groundwater Withdrawal and impacts to wetland vegetation and animal life, recreational trampling of kettle pond, shoreline vegetation, Horseshoe Crab Harvesting
- **Development Associated Issues include:** Residential Development within and especially immediately adjacent to the park, leading to: Habitat Fragmentation and increases in road kills, increased pet predation on native wildlife, groundwater withdrawal and septic inputs, increased levels of human activity/disturbance within the park.
- **Landscape/Vegetation Issues include:** Landscape significantly altered by Europeans over nearly 4 centuries. Much of vegetation is a post-agrarian mix of native and alien species, Alien species dominate in many places, Even in native dominated vegetation, community structure does not represent natural condition, Fire suppression impacts, Loss of grassland/heathland habitats-determining relative amounts that were natural versus anthropogenic.
- **Recreational Impacts include:** Numerous social trails/trampling of vegetation/mountain bike trails, Jet Skis, Pets off leash/hunting dogs, releasing non-native pheasants for put/take hunting, trampling of dune vegetation.

- **Preservation of Native Species Biodiversity include:** Determining extent to which all of the issues listed above contribute to this issue, except for federal listed species, status and distribution of most state-listed species is unknown, out of date, incomplete. Many other species of formerly common species appear to be declining. Data on their status and distribution are lacking. Others appear to have disappeared in recent years. Loss of heathland grassland habitat and declines in associated wildlife species.
- **Shoreline Dynamics include:** Accelerated rates of erosion due to recreational impacts dredging/deposition of spoil

Gateway National Recreation Area (GATE)

Staten Island, NY

Visitation 6,813,607

Gateway is 26,645 acres of coastal uplands, freshwater ponds, marshes, bays and mudflats. Established in 1972, it is divided into three geographically separate units that constitute some of the largest and most significant natural areas remaining in the metropolitan New York City area. They include the Jamaica Bay/Breezy Point Unit (Riis Park, Fort Tilden, Breezy Point Tip, Floyd Bennett Field, Plumb Beach, north shore of Jamaica Bay and the 9,155 acre Jamaica Bay Wildlife Refuge); the Staten Island Unit (Great Kills Park and Miller Field) and the Sandy Hook Unit.

Jamaica Bay/Breezy Point Unit-The Jamaica Bay habitat complex is located on the southwestern tip of Long Island in the boroughs of Brooklyn and Queens, New York City and the town of Hempstead, Nassau County. The bay connects with Lower New York Bay to the west through Rockaway Inlet and is the westernmost of the coastal lagoons on the south shore of Long Island. Breezy Point is the western tip of the Rockaway barrier beach to the south of Jamaica Bay and Rockaway Inlet. This habitat complex includes the entire Jamaica Bay estuarine lagoon, part of Rockaway Inlet, and the western part of the Rockaway barrier beach. The boundary of this area generally follows the shoreline of Jamaica Bay and includes most of the tidal creeks and undeveloped upland areas adjacent to the bay; these serve as buffers for the bay, as upland habitat, and as existing and potential restoration sites.

The western end of the Rockaway barrier beach and the Marine Park/Plumb Beach area include beach and dune habitat for nesting bird and rare plant species. The bay proper and portions of Rockaway Inlet encompass important breeding and juvenile nursery habitat for fisheries as well as year-round foraging areas for waterfowl, shorebirds, and colonial nesting waterbirds. The extensive salt marsh and upland islands in the bay provide nesting habitat for gulls, terns, waterfowl, and herons; foraging and roosting habitat for shorebirds and waterbirds; upland sites for grassland bird nesting and foraging areas; and butterfly concentration areas. Despite the surrounding intensive residential, commercial, and industrial development, Jamaica Bay and Breezy Point continue to be incredibly valuable for resident and migratory fish and birds and for other wildlife and plant populations.

Jamaica Bay is a saline to brackish, eutrophic (nutrient-rich) estuary covering about 10,118 hectares (25,000 acres), with a mean depth of 4 meters (13 feet), a semidiurnal tidal range averaging 1.5 meters (5 feet), and a residence time of about 33 days. The bay communicates with

Lower New York Bay and the Atlantic Ocean via Rockaway Inlet, a high current area that is one kilometer (0.63 mile) wide at its narrowest point, with an average depth of 7 meters (23 feet). Measurements taken during recent surveys in Jamaica Bay indicate average yearly ranges for temperature of 1 to 26°C (34 to 79°F), salinity of 20.5 to 26 parts per thousand, dissolved oxygen of 3.5 to 18.5 milligrams/liter, and pH of 6.8 to 9. Loadings of nutrients and organic matter into the bay from sewage treatment plants and runoff result in phytoplankton blooms and high suspended solid concentrations that, in turn, result in turbid water and low bottom dissolved oxygen concentrations. Jamaica Bay is in the middle of the New York City metropolitan area and the uplands around the bay, as well as much of the Rockaway barrier beach, are dominated by urban, residential, commercial, and industrial development. The bay itself has been disturbed by dredging, filling, and development, including the construction of Floyd Bennett Field and John F. Kennedy Airport. About 4,856 of the original 6,475 hectares (12,000 of the original 16,000 acres) of wetlands in the bay have been filled in, mostly around the perimeter of the bay. Extensive areas of the bay have been dredged for navigation channels and to provide fill for the airports and other construction projects.

In spite of these stressors, Jamaica Bay has been designated and mapped as an otherwise protected beach unit pursuant to the federal Coastal Barrier Resources Act. The New York State Natural Heritage Program, in conjunction with The Nature Conservancy, recognizes Breezy Point as a Priority Site for Biodiversity (B2 - very high biodiversity significance). Jamaica Bay and Breezy Point have been designated as Significant Coastal Fish and Wildlife Habitats by the New York State Department of State, and the bay up to the high tide line was designated as a Critical Environmental Area by the New York State Department of Environmental Conservation. New York City's Department of City Planning also designated Jamaica Bay as one of three special natural waterfront areas.

The center of the bay is dominated by subtidal open water and extensive low-lying islands with areas of salt marsh, intertidal flats, and uplands important for colonial nesting waterbirds. The average mean low tide exposes 142 hectares (350 acres) of mudflat, 375 hectares (925 acres) of low salt marsh dominated by low marsh cordgrass (*Spartina alterniflora*), and 213 hectares (526 acres) of high marsh dominated by high marsh cordgrass (*Spartina patens*). The extensive intertidal areas are rich in food resources, including a variety of benthic invertebrates and macroalgae dominated by sea lettuce (*Ulva latuca*). These rich food resources attract a variety of fish, shorebirds, and waterfowl. This area is largely separated from disturbance and predation occurring on the surrounding mainland, and support large numbers of nesting waterbirds and diverse migratory birds throughout the year. At least 326 species of birds have been sighted in the Refuge, including confirmed breeding by 62 species.

Breezy Point contains an approximately 81-hectare (200-acre) natural area at the western tip of the Rockaway Peninsula with an accreting wide ocean beach, beachgrass dunes, grassland/shrub thicket, and fringing salt marshes on the bay side. A stone jetty extends out from the tip of Breezy Point. East of this natural area, the barrier behind the beach front has been largely developed into residential, commercial, and recreational areas. The ocean beach narrows to the east and contains numerous short groins.

Floyd Bennett Field is a 579-hectare (1,448-acre) historic civic aviation facility dominated by human-made structures and runways but with extensive areas of open space between the runways, including a 57-hectare (140-acre) grassland area restored and maintained by the National Park Service and New York City Audubon Society as the Grassland Restoration and Management Project; smaller areas of shrub thicket dominated by bayberry, winged sumac (*Rhus copallina*), and Japanese knotweed (*Polygonum cuspidatum*); developing woodland consisting of black cherry, grey birch (*Betula populifolia*), and cottonwood (*Populus deltoides*); common reed (*Phragmites australis*) marsh; and small areas of low marsh and mudflat along the shoreline of the bay.

The location of Jamaica Bay and Breezy Point and the rich food resources found there make it a regionally important fish, wildlife, and plant habitat complex. Jamaica Bay is located adjacent to the confluence of the New York Bight and New York Bay, and is at the turning point of the primarily east-west oriented coastline of New England and Long Island and the north-south oriented coastline of the mid-Atlantic coast. This geographic location acts to concentrate marine and estuarine species migrating between the New York Bight portion of the North Atlantic and the Hudson-Raritan Estuary. The coastlines in both directions concentrate Shorebirds, raptors, waterfowl, landbirds, and various migratory insects. These migratory species are further concentrated by the surrounding urban developed land into the remaining open space and open water of Jamaica Bay. Jamaica Bay and Breezy Point support seasonal or year-round populations of 214 species of special emphasis and listed species, incorporating 48 species of fish and 120 species of birds.

Staten Island Unit -The Great Kills Harbor and Park include large areas of disturbed common reed marsh with grassland and shrub thicket at Crookes Point. The outer shoreline follows a narrow, sandy, groined beach. A large area of flats in Great Kills Harbor extends southwest along the Staten Island Shoreline as far as Wolfe's Pond.

Staten Island supports an unusual diversity of habitat types and rare plant species due to its complex geology and glacial history. The significance of this complex relates to its geographic location and to the variety and quality of habitat types found here. These include shallow estuarine open waters, sandy beach, maritime forest, salt marsh, mudflats, and riparian forest. These habitats support a large number of regionally rare and important species.

Sandy Hook Unit- The Sandy Hook Peninsula separates the Atlantic Ocean from the southern portion of the New York - New Jersey Harbor Estuary. It is the only undeveloped barrier beach area on the northern end of the New Jersey coastline.

Raritan and Sandy Hook Bays form the southeastern portion of the New York - New Jersey Harbor between the southern shoreline of Staten Island, New York, and the northern shoreline of Monmouth County, New Jersey. Raritan and Sandy Hook Bays are divided between the states of New Jersey and New York, and receive direct inflow from the Raritan River, the Shrewsbury and Navesink Rivers, and numerous smaller tributaries along the shorelines of Staten Island and New Jersey. Raritan Bay-Sandy Hook Bay is a large embayment measuring nine by twelve miles (109 square miles) with a surface area of about 28,000 hectares (69,188 acres). The inshore portion of the bays within this habitat complex has a total area of 13,500 hectares (33,500 acres).

The bay is relatively shallow, usually less than 6 meters (20 feet) in depth except for dredged channels that range in width from 24 to 427 meters (80 to 1400 feet) and are 3 to 11 meters (10 to 35 feet) in depth. The tidal range averages 1.7 meters (5.5 feet). The area is subject to a wide variety of fluctuations in temperature, salinity, and dissolved oxygen, both from natural and anthropogenic activity, especially industrial and sewage effluent and storm-water runoff.

The shorelines of Raritan and Sandy Hook Bays have more remaining natural shoreline and open space compared with other parts of the New York-New Jersey Harbor Estuary. The inshore portion of the bays within this habitat complex has a total area of 13,500 hectares (33,500 acres). The wetlands, uplands, and nearshore waters form a bayshore complex that is critical for migratory and resident birds and fish.

As is true with Jamaica Bay and Breezy Point on the other side of the New York Harbor entrance, Sandy Hook and Sandy Hook Bay are at the turning point of the primarily east-west oriented coastline of New England and Long Island and the north-south oriented coastline of the mid-Atlantic coast. This geographic location and configuration acts to concentrate marine and estuarine species migrating between the New York Bight portion of the North Atlantic and the Hudson-Raritan Estuary. Also, shorebirds, raptors, waterfowl, landbirds, and a variety of migratory insects migrating in both directions are concentrated in the Harbor by these coastlines. These migratory species are further forced by the surrounding urban developed land into the remaining open space and open water of Raritan and Sandy Hook bays and surrounding coastlands. There are 205 species of special emphasis regularly using the waters and shorelands of Raritan Bay and Sandy Hook.

The Sandy Hook Peninsula serves as a dividing line between certain groups of species, with marine, estuarine, and anadromous species concentrated on the outside, shorebirds and waterfowl concentrated on the inside, and migratory landbirds (raptors and passerines) concentrated on the peninsula itself.

Maritime holly forests that occur at the Sandy Hook Unit occur at only a few other locations in the region and are a globally imperiled community due to their rarity. The forests are important as roosting and nesting locations for a variety of birds, and include historical nesting by great blue heron, historical nesting and present roosting by black-crowned night-heron (*Nycticorax nycticorax*), and nesting by several pairs of osprey and several species of passerines. The holly is also a host plant for the regionally rare butterfly Henry's Elfin (*Incisalia henrici*).

Its sandy shorelines and backdunes provide germination and breeding habitats for a variety of threatened, endangered and rare species of flora and fauna.

GATE's current management issues include:

- **Urban/Development Associated Impacts:** Jamaica Bay is in the middle of the New York City metropolitan area and the uplands around the bay, as well as much of the Rockaway barrier beach, are dominated by urban, residential, commercial, and industrial development. Consequently, issues such as habitat fragmentation, increases in road kills, increased pet predation on native wildlife and increased levels of human activity/disturbance within the park must be considered.

- **Adjacent land uses that impact on aquatic systems-** Loadings of nutrients and organic matter into Jamaica Bay from sewage treatment plants and runoff result in phytoplankton blooms and high suspended solid concentrations that, in turn, result in turbid water and low bottom dissolved oxygen concentrations. At Sandy Hook, the surrounding waters are subject to a wide variety of fluctuations in temperature, salinity, and dissolved oxygen, both from natural and anthropogenic activity, especially industrial and sewage effluent and storm-water runoff.
- **Loss of Marsh habitat/islands in Jamaica Bay-**The bay has been disturbed by dredging, filling, and development, including the construction of Floyd Bennett Field and John F. Kennedy Airport. About 4,856 of the original 6,475 hectares (12,000 of the original 16,000 acres) of wetlands in the bay have been filled in, mostly around the perimeter of the bay. Extensive areas of the bay have been dredged for navigation channels and to provide fill for the airports and other construction projects. Current scientific research shows Jamaica Bay losing a significant amount of marsh habitats and islands annually. Jamaica Bay and its associated marsh habitats are noted as critical for several species of breeding birds and fish as well as for growth and development of birds, fish, diamondback terrapins and some sea turtles.
- **Wildlife Management Issues include:** Aircraft collision with birds originating in GATE; Neotropical migrants use of park habitats; Other wildlife species that have the potential to impact on piping plover (federally listed species) and other beach nesting birds such as roseate tern, American oystercatcher and black skimmer (all state listed species); potential rabies vectors such as raccoons;

Fire Island National Seashore (FIIS)

Patchogue, NY
Visitation 559,764

Fire Island National Seashore is a barrier island located along the southern coast of Long Island, New York. The island is approximately 51 km long and averages about 0.5 km in width. The island is bordered by the inlets of Fire Island to the west and Moriches to the east and is separated from Long Island by the Great South and Moriches Bays.

The Fire Island National Seashore (FIIS) consists of 42 km of Fire Island. FIIS is 19,300 acres of which approximately 11,000 acres are submerged in the Great South Bay or Atlantic Ocean. This figure does not include Smith Point County Park located at the eastern end within the boundaries of the National Seashore. Eleven kilometers of eastern Fire Island, between Smith Point and Watch Hill, comprise the only federally designated wilderness in the state of New York and in national parks of the northeastern United States. The Smith Point County Park (from Smith Point West to Moriches Inlet) falls within the boundary of the National Seashore but is administered by the Suffolk County Park Commission. Robert Moses State Park, on the western end of Fire Island, is not within the authorized boundary of FIIS and is managed by the Long Island State Park Regional authorities.

Other parts of Fire Island have more extensive development. Seventeen private resort communities comprising approximately 4,000 homes, lie within the administrative boundary of FIIS on the western end of the island. The presence of these communities that are themselves part of the National Seashore complicates management of the park's natural resources. These

communities can be accessed either by boat across the Great South Bay or by vehicle via the Robert Moses Causeway.

The William Floyd Estate (FIIS-WFE), located across Great South Bay on Long Island mainland, is quite different from FIIS's barrier island. The William Floyd Estate is 65% forested, 25% wetlands including salt marsh, 5% open space and 5% developed around the estate house area. Species found at FIIS-WFE include great blue herons, great and snowy egrets, willets, and diamondbacked terrapin inhabit the salt marsh.

The physiognomy of Fire Island is typical of Atlantic barrier islands which grade from a primary dune along the ocean to salt marsh along the bay. Dominant vegetation common to Fire Island includes pitch pine (*Pinus rigida*), beach grass (*Ammophila breviligulata*), wax myrtle (*Myrica cerifera*), bayberry (*M. pensylvanica*), shadbush (*Amelanchier canadensis*), and common greenbrier (*Smilax rotundifolia*). This particular composition of vegetation is typical of Fire Island except within the various communities where residents have planted non-indigenous vegetation.

Terrestrial habitats of FIIS include 10% forested and 40% wetlands, 25% open (beach, swale and fields) and 25% developed by NPS and 17 local communities on the island. Of the submerged portion, 80% is in Great South Bay and 20% is the Atlantic Ocean. All existing habitats within FIIS are listed as threatened. Unique Resources include the Sunken Forest, which is a maritime Holly Forest; a Federal Wilderness Area (1300 acres); eel grass beds. The Sunken Forest on Fire Island is a 16-hectare (40-acre) maritime oak-holly forest occurring behind the secondary dune, one of only a few mature maritime forests in the New York area and the northernmost holly-dominated maritime forest on the Atlantic barrier island chain. This community type is considered globally imperiled (G2) by The Nature Conservancy.

Approximately 10 Federal or NYS Endangered species breed or germinate in this park. There are eleven species of concern found within the park habitats as well. The white-tailed deer is, perhaps, the Park's most conspicuous natural resource. Thousands of visitors are attracted to Fire Island each year for the opportunity to view deer roaming in a natural barrier island setting.

FIIS's current management issues include:

- **Aquatic Resources**-The chemical and biological condition of FIIS salt water estuaries is unknown. State Fisheries data indicate finfish and shellfish populations are stressed due to pollution and degradation of habitat near FIIS. Identifying impacts to aquatic resources possibly due to channel and marina dredging and pollution from community marinas is needed.
- **Air Resources**-There is a general lack of knowledge regarding air quality on FIIS; Monitoring is needed.
- **Recreation and Visitor Use impacts**-Issues include preventing primary dune vegetation loss due to pedestrian and vehicle disturbance; controlling the extent of human disturbance on plant species in sensitive areas such as The Wilderness Area and the Sunken Forest and controlling the use of personal watercraft due to aesthetic impacts.
- **Impacts to Aesthetic Resources**-Aesthetic concerns include structures, bulkheads, groins, beach scraping and barrier island uses

- **Lateral sand transport**-Bottom dredging of the marina channels disrupts bayside lateral sand transport. The groins on the Ocean Beach impact lateral sand transport on the ocean side. Extensive study of sand transport on FIIS is needed.
- **Mosquito management**-The extent of public threat due to Eastern Equine Encephalitis at areas on FIIS is being investigated and there is a need to determine the applicability of Open water Marsh Management to decrease mosquito populations.
- **Adjacent land use**-Determining impacts of water quality due to heavily populated region
- **Exotic species management**-The dominance of exotic species on Fire Island is not being studied sufficiently. Preliminary studies suggest exotic plants in the private communities on FIIS may be encroaching onto federal lands (i.e. bamboo). Also Phragmites continues to increase in the marsh areas if the Wilderness.
- **Shoreline change**-There is a need to continue to monitor shoreline change to determine the extent of change seasonally and after unusually strong storms
- **Saltmarsh restoration**-Monitoring and research is required to determine if passive restoration is the best action at this time.

GATE and FIIS in relation to “The New York Bight”

The New York Bight is generally defined as that region of the Atlantic Ocean enclosed within the area from Montauk Point, Long Island, to Cape May, New Jersey including both GATE and FIIS, seaward to the edge of the continental shelf. The complex of bays and lagoons, sandy barrier islands, tidal streams and creeks, and river mouths is a significant feature of this area. The Bight has a vast continental shelf, extending seaward nearly 160 kilometers (100 miles), and can be characterized as having a gentle slope and two ancient river valleys, the Hudson and Block canyons, as well as numerous shoals and sand ridges in the near coastal area. The Bight proper forms a triangle, with the apex at New York City (Hudson River) and the base stretching across the edge of the continental shelf.

Colonial National Historical Park (COLO)

Yorktown, VA

Visitation 3,136,262

Colonial National Historical Park's (COLO) 9,327 acres are located within the coastal plain of the Tidewater Virginia area. The entire park has a direct hydrological link to the Chesapeake Bay. COLO is composed of Jamestown Island (1500 acres), Yorktown Battlefield (4300 acres), and the Colonial Parkway (3600 acres) that connects the two. Within this area, the park's habitats include 37 miles of shoreline (34 acres), 55 miles of streams (55 acres)-approximately 24 miles of perennial streams and 30 miles of intermittent streams, 2482 acres of wetlands, 3061 acres of floodplain, 5540 acres of forest and 1106 acres of managed fields. In addition, the park contains 4225 acres of Chesapeake Bay Regulatory Areas (Resource Protection Areas and Resource Management Areas). It harbors 11 rare, threatened or endangered faunal species, and 6 floral species. It provides nesting habitat for both American bald eagles and great blue herons,

and contains Dry Calcareous Forest, a rare community type identified by the VA Division of Natural Heritage.

Begun in 1931, the Colonial parkway was completed in 1957 linking Yorktown Battlefields with the Jamestown 1607 settlement. This is a 23-mile roadway. The eastern portion of the Parkway parallels the tidal salt water of the York River. Mature deciduous and Loblolly Pine forests bound its salt-marsh tributaries. The Williamsburg section is predominately deciduous forest with intermittent suburban communities. The western end of the Parkway to Jamestown parallels the brackish James River, crossing several brackish to freshwater creeks and marshes. Deciduous hardwood and Loblolly Pine stands are scattered along the way.

COLO's current management issues include:

- **Shoreline Change:** River shoreline erosion along the shorelines of COLO is significant. It is caused by normal and storm induced wave activity and visitor recreational use. Recent research has provided a better understanding of the shoreline erosion process, those areas experiencing the highest erosion rates and recommendations for conserving the shoreline and its associated cultural and natural resources.
- **Estuarine water quality:** Loss of submerged aquatic vegetation (SAV's) within estuarine habitats at COLO has been noted. Current estuarine water quality within this area is unknown.
- **Aquatic impacts from adjacent land use:** COLO is located adjacent to a rapidly developing urban/suburban area. The entire park has a direct hydrological link to the Chesapeake Bay. Numerous streams, creeks and ponds with major portions of their drainage basin upstream and outside of park boundaries, flow through the park and feed directly into the York or James River. Preliminary analysis of physical attributes and benthos in some of these streams indicate that they are impaired. Activities from adjacent urban and agricultural development may have a detrimental effect on water quality within the park.
- **Groundwater contamination:** Testing indicates potential local sources of groundwater contamination from nitrate and ammonia at several sites near Jamestown Island, Williamsburg and Yorktown. The US Geological Survey, USGS is conducting a study to develop the hydrogeological framework of the Yorktown area of the park and surrounding environs.
- **Visitor and recreational use impacts/Endangered species protection:** COLO has the second highest number of rare, threatened and endangered species of all the National Park Service units in the state. Visitor impacts and recreational activity effects on rare, threatened and endangered species and other species is unknown.
- **Exotic species management:** Currently the impacts of exotic species on native species and rare/sensitive habitats is unknown.

George Washington Birthplace National Monument (GEWA)

Washington's Birthplace, VA
Visitation 127,449

The George Washington Birthplace National Monument (GEWA) is located on the Northern Neck of rural and tidal Virginia about 45 miles east of Fredericksburg on highway 3 and about 80 miles south of Washington, D.C. in Westmoreland County.

The park is fairly flat, typical of the Coastal Plain, and is comprised of about 551 acres of lands bounded by the Potomac on the north, Pope's Creek estuary in the east and south and private land to the south and west. Salinity of Pope's Creek and other brackish water marshes within the park can be as much as 60% seawater. Habitats include about 280 acres of open grasslands (pasture and mowed), 220 acres of forests (heavily wooded and steep ravines with mixed deciduous hardwoods including large mature poplars, oaks and hickories; pine and red cedar forests), 25 acres of freshwater and brackish marshes and estuaries, 18 acres of memorial cultural landscapes, 5 acres of Potomac River beaches and dune habitats, and 3 acres of developed lands.

The majority of forests within GEWA range in age from 90 to 120 years in age. The oldest trees are Black Gums and approach 180 years in age (*Nyssa sylvatica*). Upland forested areas of the park are dominated by a unique assemblage of loblolly pine (*Pinus taeda*) and willow oak (*Quercus phellos*). Other species include sweetgum (*Liquidambar styraciflua*), copious American holly (*Ilex opaca*) and Eastern red cedar (*Juniperus virginiana*), American beech (*Fagus grandifolia*), oaks (*Quercus* sp., primarily white *Q. alba* and southern red *Q. rubra*), Virginia pine (*Pinus virginiana*), red maple (*Acer rubrum*), pawpaw (*Asimina triloba*) and an occasional tuliptree (*Liriodendron tulipifera*). The herb and layer is sparse due to canopy shading and deer over grazing.

As upland habitats loose elevation, fresh and saltwater marshes begin to dominate. Upstream, at the headwaters of the Bay tributaries, are fresh water marshes that are wooded (maple/ash, and few loblolly pine) and shrubby (bay species, swamp rose, marsh mallow, marsh hibiscus, sagitaria, grasses (wild rice), sedges, and rushes).

Freshwater marshes gradually come under the influence of tidal activity and the influx of brackish water. These tidal estuaries are important breeding and nursery grounds for fish and birds. Cattails, switchgrass and cordgrass, bulrush, marsh hibiscus, baccharis, wax myrtle, and marsh elder dominate this ecosystem. However, most of these ecosystems and species have never been fully described within the park. Much of this ecosystem is found at the mouths of streams and along the shores of Popes Creek. There are numerous islands that are found within Popes Creek with these dominant vegetation types. Phragmites is a concern in both fresh and brackish water marshes.

Management issues at GEWA include wildlife management, reintroduction of native warm-season and meadow species, shoreline stabilization, beach and bar management, marsh management, forest management, exotic species, management for T&E species, complete inventories and conduct monitoring of all terrestrial and aquatic fauna and flora including invertebrate species, and GIS all habitats.

GEWA's current park management issues include:

- **Shoreline Change:** Erosion along the Potomac shoreline is severe and represents significant threats to estuarine water quality, salt marsh health and biotic diversity. Documentation of the impacts from erosion at GEWA including loss of plant species is needed to provide a better understanding of the shoreline

erosion process, those areas within GEWA experiencing the highest erosion rates and recommendations for conserving the shoreline and its associated cultural and natural resources.

- **Water quality**-Extensive testing or documentation of freshwater and estuarine water quality is required to determine potential contaminant impacts to aquatic habitat health at GEWA. This work is essential in order to begin the process of possibly restoring Pope's Creek as a spawning area for species such as oysters and sturgeon
- **Wildlife Management**- Issues include protection of rare, threatened and endangered wildlife species; appropriate deer and woodchuck population management
- **Habitat management**- Issues include documentation of habitat health within forested and marsh areas; native warm-season and meadow grass species re-introduction; protection of rare, threatened and endangered vegetative species
- **Exotic species management**-Currently the impacts of exotic species on native species and rare/sensitive habitats is unknown.

Thomas Stone National Historical Site (THST)

Port Tobacco, VA
Visitation 4,038

Thomas Stone National Historic Site is located in Charles County, Maryland approximately 25 miles due south of Washington, D.C. and 4 miles west of La Plata, MD. Private lands bound the park to the north and south, Rose Hill Road on the east, and Hog Hole Run on the west. There are approximately 297 acres of federally owned property and 6 acres of privately owned land encompassed by the legislated boundary. The site is comprised of hilly lands that drain into the Hoghole Run, emptying into the Port Tobacco Creek. Relief of the landscape is approximately 35 meters with three main drainages and numerous springs and seeps. About 180 acres are mixed forests, 110 acres of maintained open fields, 5 acres of riparian habitat and 2 acres of maintained lawns. Structures on the park include the Thomas Stone Mansion and associated farm buildings constructed in the 18th-19th Centuries, the Stone family graveyard, and various 20th century support buildings.

The majority of park lands fall within the Hog Hole Run sub-basin, which is a tributary of the Port Tobacco River. Hog Hole Run, a perennial stream, lies adjacent to the western boundary of Thomas Stone NHS. The entire stream course along the park boundary is encompassed by an electric power line right-of-way for the Southern Maryland Electric Cooperative. Beaver colonies have been established along Hog Hole Run, which have resulted in wetland areas. Some of these wetlands extend onto park lands.

Two perennial, unnamed streams can be found within the park. The primary sources of water for these streams are springs, seeps, and precipitation. The courses of both streams follow deep ravines; one on the east side of the park, and one adjacent to the Mansion House area. A man

made pond, with an area of approximately 1/2 acre, is found near the park entrance. This pond is spring fed, with a small outlet to an intermittent creek.

A systematic inventory of the park's fauna and flora has not been conducted. Generally, vegetation within the park is typical of that found in the Mid-Atlantic portion of the Coastal Plain and throughout southern Maryland.

The majority of forests within THST range in age from 40 to 70 years in age. Most trees are fairly young and even aged, except for an occasional large beech or oak tree. Upland forested areas of the park are dominated by American beech (*Fagus grandifolia*), oaks (*Quercus* sp., primarily white *Q. alba* and southern red *Q. rubra*), and yellow poplar (*Liriodendron tulipifera*). The herb and shrub layer is sparse due to past livestock and current deer over grazing.

The upland/lowland transition zone includes sweetgum (*Liquidambar styraciflua*) and large specimens of American holly (*Ilex opaca*). The herb layer in this area includes ferns, *Leiopodium*, and *Gordyera* sp. Ironwood (*Carpinus caroliniana*) can be found in the lowland areas of the park. The herb layer includes ferns, nettles, Japanese honeysuckle (*Lonicera japonica*), *Corydalis flavula*, sedges (*Carex rosea* and other species), chickweed (*Stellaria* sp.), and large-seeded forget-me-not (*Myosotis macrosperma*). Additional tree species found throughout the park include: Virginia pine (*Pinus virginiana*), hickory (*Carya* spp.), red maple (*Acer rubrum*), pawpaw (*Asimina triloba*) and blackgum (*Nyssa sylvatica*).

A park volunteer has recorded 109 avian species at THST. Species found at the park are typical of the mid-Atlantic region of the Coastal Plain. Casual observance of species that utilize the park indicate populations of mammals common to the Mid-Atlantic States. Species found in the park include: raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), Eastern cottontail rabbit (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), and a large population of white-tailed deer (*Odocoileus virginiana*).

An active beaver (*Castor canadensis*) colony is located adjacent to the park boundary and within Hoghole Run. This colony makes use of trees located within the park along the margins of the stream.

THST's current park management issues include:

- **Wildlife Management-** Issues include a need for documentation of wildlife species composition, distribution and abundance and habitat use; need for documentation of rare, threatened, endangered and exotic wildlife species; determining effects of hunting and power line rights of way on species; deer browse monitoring
- **Habitat management-** Issues include a need for documentation of park vegetation species composition, distribution and abundance; a need for documentation of rare, threatened, endangered, exotic and invasive vegetative species; a need for documentation of habitat health within forested and riparian areas; determining effects of power line rights of way on species; native warm-season and meadow grass species re-introduction.

- **Public Education-**There is a need to provide increased public education about the natural environment around THST

Sagamore Hill National Historic Site (SAHI)

Oyster Bay, NY
Visitation 67,193

Sagamore Hill National Historic Site is located on the peninsula of Cove Neck, Long Island, New York. It encompasses 87 acres, which includes a parking lot and visitor center (2 acres combined); paved driveways and mowed lawns (10 acres); 12 acres of rough fields; approximately 12 acres of saltmarsh and about 50 acres of mature forest dominated by mature oak-tulip-hickory.

The easternmost forested and saltmarsh area of the park were declared a "Natural Environmental Study Area" by Congress in the early 1970's. The Eel Creek saltmarsh is an excellent example of the tidal saltmarshes that once lined the shore of Long Island.

There has been very little inventory work done at Sagamore Hill. Dr. Richard Stalter of St. John's University conducted an herbaceous plant survey in the early 1990's. He also conducted a survey of vascular plants at SAHI between from 1995 through October 1996.

SAHI's current park management issues include:

- **Wildlife Management-** Issues include a need for documentation of wildlife species composition, distribution and abundance and habitat use; need for documentation of rare, threatened, endangered and exotic wildlife species.
- **Habitat management-** Issues include a need for management recommendations regarding park habitats based on previous documentation and current field work

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Maps of Parks



Figure 1. Assateague Island National Seashore Visitor Map



Figure 2. Cape Cod National Seashore Visitor Map

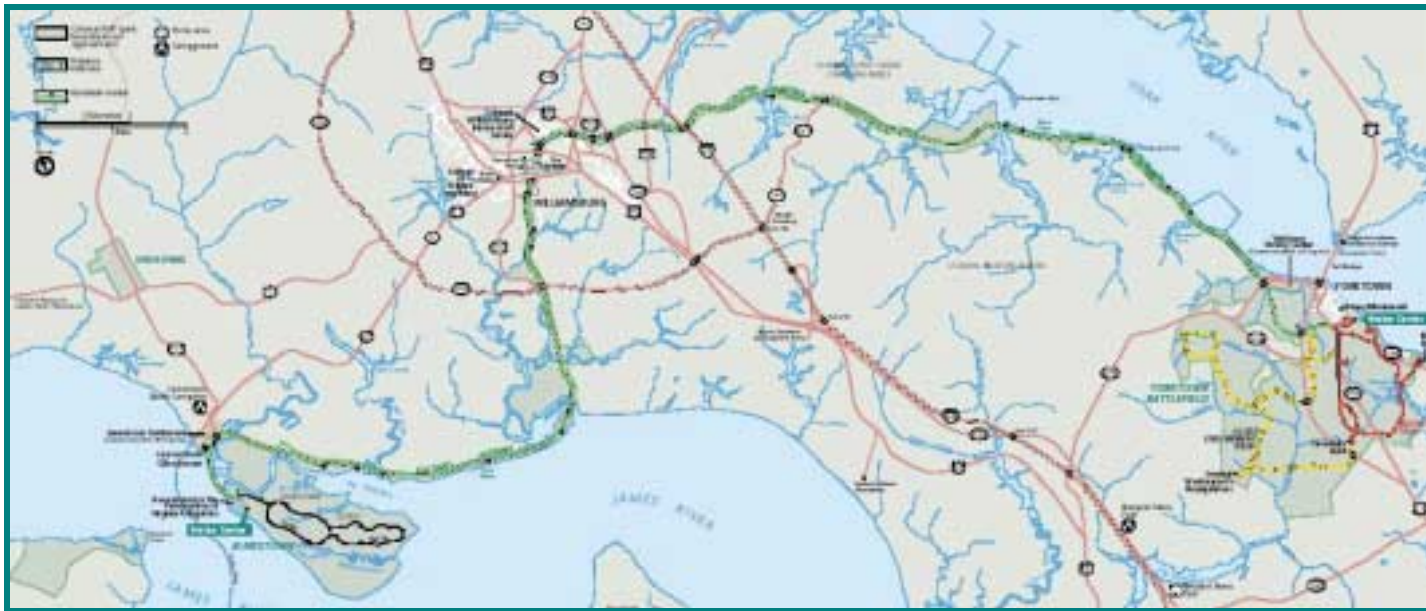


Figure 3. Colonial National Historical Park Visitor Map



Figure 4. Fire Island National Seashore Visitor Map



Figure 5. Gateway National Recreation Area Visitor Map

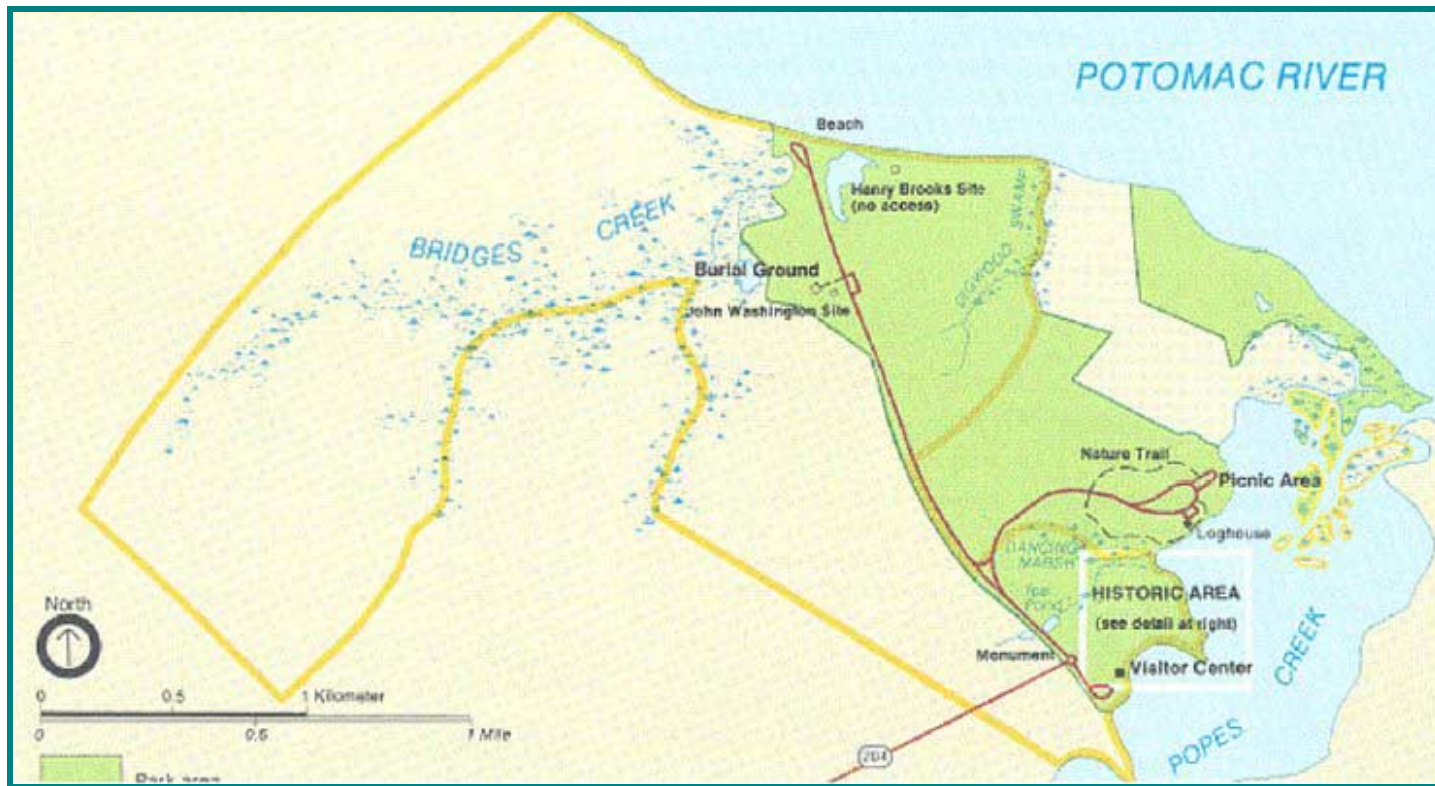


Figure 6. George Washington Birthplace National Monument Visitor Map

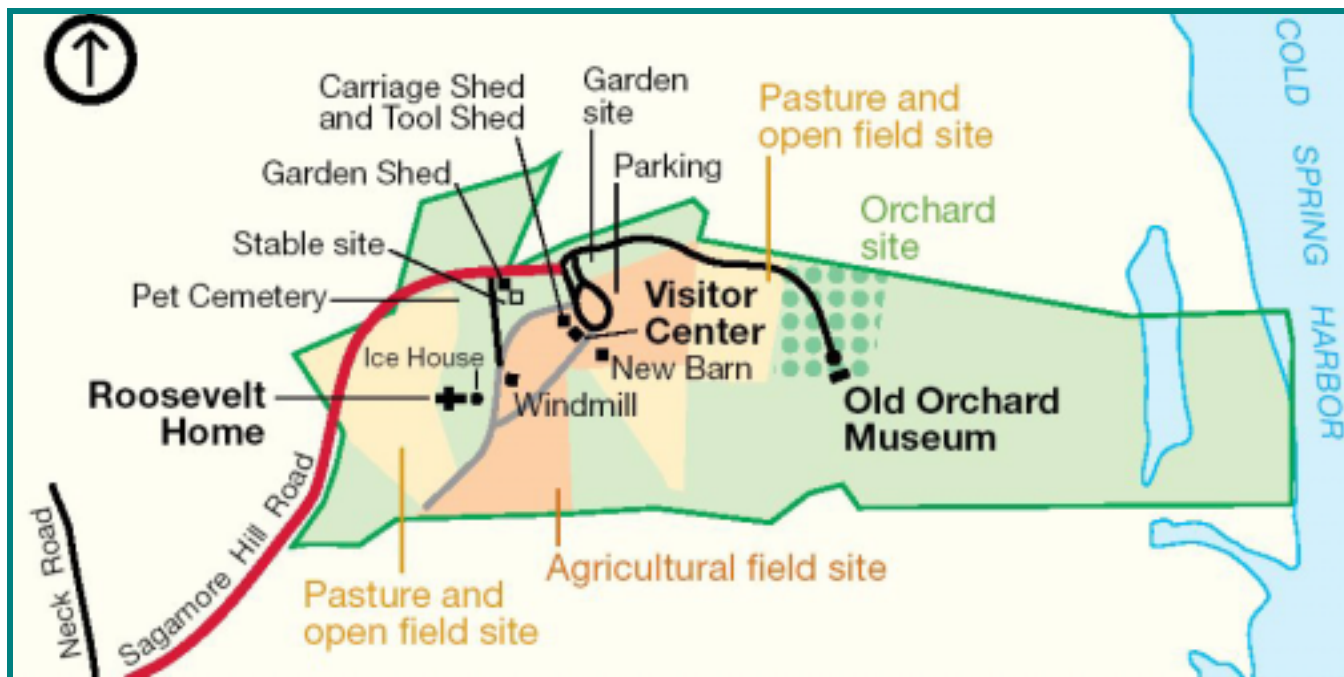


Figure 7. Sagamore Hill National Historic Site Visitor Map

Chapter II. Avian Monitoring

Section I. Introduction

Birds are important participants within ecosystems due to their high species diversity and use of a variety of ecosystem niches. From the ground to the top of the canopy, birds can be either prey or the top predators within a food chain.

They are vital to park ecosystems. They help to control insect populations, aid in pollination of a variety of plants and trees, attract human interest and ultimately monetary support of the park mostly through bird watching and hunting activities.

Birds use habitats within C&B network parks for breeding, migration, wintering or throughout the year. There are several species of birds that are known to use particular habitats within the C&B parks for breeding. Some of these species are listed as endangered or threatened such as the piping plover use of beaches and bald eagle use of shoreline snags respectively. Some known breeding species of birds within the C&B parks are listed in Tables A-1. and A-2. with their associated breeding habitats. Many of the C&B parks contain large tracts of these habitats due to the amount of land encompassed by the park. However, there is concern that not all species of breeding birds, particularly marsh and grassland species have been documented within each C&B Park.

The Atlantic Flyway may be described as extending from the offshore waters of the Atlantic Coast west to the Allegheny Mountains where, curving northwestward across northern West Virginia and northeastern Ohio, it continues in that direction across the prairie provinces of Canada and the Northwest Territories to the Arctic Coast of Alaska. The flyway embraces several primary migration routes and many more that are important as tributaries, some of the latter being branches from primary routes of other flyways.

The coastal route of the Atlantic Flyway, which in general follows the shoreline, has its northern origin in the eastern Arctic islands and the coast of Greenland. This is a regular avenue of travel, and along it are many famous points for the observation of migrating land and water birds. Also, In the autumn, some of the shore birds that nest on the Arctic tundra of Mackenzie and Alaska, fly southeastward across Canada to the Atlantic coast and finally follow this oceanic course to the mainland of South America.

The importance of the Atlantic coastal route to migrating birds is exemplified at Cape May, New Jersey, where birds are funneled down to a single point by the coastline and prevailing winds. Millions of songbirds pass through Cape May each fall and 70,000 raptors on average are counted in the annual fall hawk watch.

The NPS Coastal and Barrier Network is located within the Atlantic Flyway along the coastal route. Within the C&B parks, there are several habitats such as beaches and estuarine mudflats

for shorebirds, forested peninsulas for landbirds and raptors and estuarine marshes for waterfowl which provide critical feeding and resting sites for these birds during both the spring and fall migration. For example, at least 326 migrating species of birds have been sighted in the Jamaica Bay NWR located within GATE.

Species of shorebirds, landbirds, raptors and waterfowl can be found wintering within the C&B parks. Waterfowl rely on estuaries primarily in the winter for their food. Seabirds and seaducks are commonly found in bay inlets and along the coastline. Bald eagles use mudflats, spits, bays and coastlines for foraging and begin nesting in early winter. Some species of passerines are found within many habitats throughout the winter. For example, during the winter season, Seaside Sparrows and Horned Larks may be found at the high-tide mark within bay habitats along the east coast.

Birds are by far the most well monitored taxa of animals in the United States and within the National Park Service. It may be assumed that if birds are well monitored there is little need to establish more monitoring programs within the C&B Network. However, parks such as SAHI, THST and GEWA have no or only a few completed bird inventories. None of these parks have had well-organized long-term avian monitoring programs conducted within their boundaries.

Most of the larger C&B Network parks have had a variety of avian short-term research projects conducted within their boundaries and most of these parks have also had monitoring programs such as the Breeding Bird Atlas or Christmas Bird Counts conducted within their boundaries. Short-term research projects by nature are not designed to look at population trends. Although useful for developing species lists and possibly deriving long-term trend data, BBA's and CBC's are of limited use when examining park health issues. Most long-term avian monitoring programs conducted within these parks have focused solely on federally listed R, T, and E species due staffing and budgetary shortfalls. Table A-3. lists all known long-term monitoring programs within the C&B parks, the type of data available from the program and any agencies that collaborated with the NPS to conduct the program.

Section II. Review of Inventory Status and Outstanding Needs of Coastal and Barrier Network Parks

Table 2-1 lists inventory needs by park as listed in the Northeast Coastal and Barrier Network Inventory Study Plan For Vertebrate and Vascular Plant Species (Stevens-Nerone, 2002). .

Table 2-1. Projected Avian Inventory needs by Park as of 2002

ASIS	It is likely that adequate (>90% completeness) inventory data documenting the avifauna of ASIS exists, but needs to be “mined” and compiled. This effort would also serve to identify any significant data gaps and guide additional inventory efforts. Beyond basic species occurrence data, information describing the distribution and abundance of breeding birds is considered the highest priority need.
CACO	It is likely that adequate (>90% completeness) inventory data documenting the avifauna of CACO exists, but needs to be “mined” and compiled. This effort would also serve to identify any significant data gaps and guide additional inventory efforts. Beyond basic species occurrence data, information describing the distribution and abundance of terrestrial breeding birds is considered the highest priority need.
COLO	Some bird inventories have been completed for certain units within COLO; however, COLO may need baseline inventories where current surveys are non-existent
FIIS	The documentation of avian species at FIIS is considered to be 90% complete. At this time, NPSpecies contains data on avian species from only two references. Once existing data is entered into NPSpecies, an expert should be asked to review the data and identify any further gaps in inventory.
GATE	Documentation of birds occurring within GATE is thought to be 90% complete. Enter existing data into the NPSpecies database.
GEWA	Baseline survey needed.
SAHI	Baseline survey needed.
THST	Baseline survey needed.

Section III. National Bird Conservation Plans

The following National Bird Conservation Plans (BCPs) are among several existing and developing planning efforts for bird conservation. BCPs are intended to complement other initiatives such as the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, and North American Colonial Waterbird Plan.

Partners In Flight Bird Conservation Plans

The goal of PIF landbird conservation planning and the BCPs is to ensure long-term maintenance of healthy populations of native landbirds. The BCPs primarily address nongame landbirds, which have been vastly under-represented in conservation efforts, and many of which are exhibiting significant declines that may be arrested or reversed if appropriate management actions are taken. The PIF approach differs from many existing federal and state-level listing processes in that it (1) is voluntary and nonregulatory, and (2) focuses proactively on relatively common species in areas where conservation actions can be most effective, rather than the frequent local emphasis on rare and peripheral populations. PIF Bird Conservation Plans therefore provide the framework to develop and implement habitat conservation actions on the ground that may prevent the need for future species listings.

Throughout the planning process and during the implementation phase, these BCPs emphasize partnerships and actions over large geographic scales. Information and recommendations in the plans are based on sound science and consensus among interested groups and knowledgeable individuals. It is a dynamic method that uses several criteria to rank a species vulnerability. Numerical scores are given for each criterion, with higher scores reflecting higher vulnerability. The most vulnerable species are those with declining population trends, limited geographical ranges, and/or deteriorating habitats. Specific methods used to complete this process are described within the plans or in their appendices. Additional details on PIF history, structure, and methodology can be found in Carter et al. (2000). A national PIF Species Assessment Database is maintained by the Rocky Mountain Bird Observatory, into which improvements are regularly incorporated.

Although priorities and biological objectives are identified at the physiographic area level, implementation of PIF objectives will take place at different scales, including individual states, federal agency regions, joint ventures, and Bird Conservation Regions (BCRs).

PIF Conservation Plans which are applicable to the NPS Coastal Network include The Southern New England (Physiographic Area 09) Conservation Plan and The Mid-Atlantic Coastal Plain (Physiographic Area 44) Conservation Plan. The Southern New England physiographic area covers parts of northern New Jersey, Southern New York including Long Island, the majority of Connecticut, all of Rhode Island, most of eastern Massachusetts, the southeastern corner of New Hampshire and south coastal Maine. This region has experienced the greatest amount of urbanization of any part of the Northeast, including the entire Boston to New York City Corridor. Urbanization and associated human activities severely threaten remaining high-priority habitats, especially maritime marshes and dunes, relict grasslands and mature deciduous forests.

Coastal Network NPS parks included in this area include CACO, FIIS, SAHI, and GATE. Table A-1. lists PIF's priority bird species pool for Area 9 and presence/absence of the listed species within the above listed parks. Species with highest total scores include the Salt Marsh Sparrow, Piping Plover, Seaside Sparrow, American Oystercatcher and the Black Rail. Table A-1. lists PIF's priority habitats-species suites for Area 9. Maritime Marshes and Beach/dune habitat were the two highest priority habitats listed for this region. Within the maritime marsh habitat Focal species noted

included the Saltmarsh Sharp-tailed Sparrow, American Black duck and the Northern Harrier. The maritime marsh habitat suite also included nine species of waders.

The mid-Atlantic Coastal Plain Region covers most of the state of New Jersey, all of Delaware, and the eastern portions of Maryland and Virginia. Coastal Network NPS parks included in this area include ASIS, TSHS, GEWA and COLO. Managing human growth while maintaining functional natural ecosystems is the greatest conservation challenge faced by land managers within the mid-Atlantic region. The living space and infrastructure required by the expanding human population has had a pervasive impact on the natural landscape, resulting in a direct change in the availability and distribution of habitats. The impact of an expanding human population on regional bird populations extends beyond the direct loss of habitat. For example, the increased demand for recreational activity has lead people further afield to remote habitats that represent the only breeding areas for many species that are sensitive to human disturbance. Invasive plant species now threaten the remaining patches of high marsh that support one of the most threatened species suites within the region. Populations of predators associated with human development have reached historic highs and have likely reduced productivity for many species across all habitat types.

Table A-2. lists PIF's priority bird species pool for Area 44 and presence/absence within ASIS, TSHS, GEWA or COLO. Species with highest total scores include the Piping Plover, Roseate Tern, Salt Marsh Sharp-tailed Sparrow, Black Rail, Seaside Sparrow, American Black Duck, King Rail, Wilson's Plover, Clapper Rail and American Oystercatcher. Table A-2. lists PIF's priority habitats-species suites for Area 44. Barrier and Bay Islands and Salt Marshes among the top three highest priority habitats listed for this region. Other priority habitats listed included Forested wetlands, Early Succession and Fresh/Brackish Emergent Wetlands. Within the Barrier and Bay Island habitat, a total of 21 bird species were listed which included six species of terns and five species of waders. PIF contact information can be found at <http://www.PartnersInFlight.org>.

In association with PIF, the Cornell Laboratory of Ornithology has recently published **A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other Forest-interior Birds**". It is the first in a forthcoming series of habitat management guidelines as a tool to help those interested in managing and protecting habitat for birds. These guidelines offer a set of "management prescriptions"—descriptions of the kinds and amounts of habitat that are required to sustain healthy bird populations. It describes the kinds and amounts of forest habitat required to sustain healthy forest bird populations. To download a PDF version of the guidelines go to <http://www.birds.cornell.edu/conservation/tanager/>.

The North American Waterfowl Management Plan

The NAWMP is an international action plan involving Canada, the United States and Mexico to conserve migratory birds throughout the continent. The Plan's goal is to return waterfowl populations to their 1970s levels by conserving wetland and upland habitat. The Plan's projects are international in scope, but implemented at regional levels. These projects contribute to the protection of habitat and wildlife species across the North American landscape.

Transforming the NAWMP into on-the-ground action relies on a cooperative approach to conservation. The work is accomplished through partnerships called Joint Ventures. Joint ventures are comprised of individuals, corporations, conservation organizations, local, state, provincial and federal agencies. Habitat joint venture actions include protection, restoration and enhancement of wetland and associated upland habitats. The species joint ventures address monitoring and research needs. Current species joint ventures include Black Ducks and Arctic nesting geese.

The goal of the Atlantic Coast Joint Venture, which encompasses the NP C&B Network, is to "protect and manage priority wetland habitats for migration, wintering, and production of waterfowl, with special consideration to black ducks, and to benefit other wildlife in the joint venture area." The specific objectives are to protect, manage, and enhance 355,787 hectares (879,138 acres) of wetland and upland buffer areas, and to improve and enhance an additional 67,171 hectares (165,977 acres) of federal and state wetland habitats currently managed for waterfowl within the Atlantic Coast Joint Venture Area, to maximize carrying capacity for waterfowl and other wildlife.

Estuarine complexes in this region which are extremely important to wintering and migrating waterfowl, including Great Bay (NH), Long Island Sound, Peconic and Great South bays (NY), Delaware Bay, Chesapeake Bay, and embayments created behind barrier beaches. Approximately 65% of the total wintering Black Duck population can be found in coastal areas between Long Island and North Carolina. Exploitation and pollution of Chesapeake Bay and Absecon Bay (NJ), and the accompanying loss of submerged aquatic vegetation, have significantly reduced their value to waterfowl.

North American Waterbird Conservation Plan:

Over the past several years, a Waterbird Monitoring Partnership comprised of non-governmental agencies, researchers, private individuals, academics, and federal and state governmental agencies was established with the goal of developing a continental network of collaborators who agree to and implement comparable population monitoring techniques and a centrally managed waterbird database. The USGS Patuxent Wildlife Research Center's Monitoring Program is coordinating this continent-wide waterbird monitoring partnership. A North American Waterbird Conservation Plan (NAWCP) was then developed. An unformatted version of the published Plan (due out August 2002) is now available for review. This version of the plan addresses in detail only those species nesting in colonies. A second version, addressing non-colonial marshbirds will be developed over the next year.

The NAWCP call for a set of standardized waterbird monitoring methods to be developed for both population and habitat at multiple geographic and temporal scales. As part of the conservation plan, a manual of recommended standardized breeding season population monitoring methodologies has been produced for use by resource agencies and NGOs, and will be updated as methods are further improved and tested (see below for link). The purpose of the monitoring manual is to provide guidance to individuals developing new waterbird monitoring programs, or interested in improving data comparability.

To view the "Breeding Season Population Census Techniques for Seabirds and Colonial Waterbirds Throughout North America" go to the <http://www.nacwcp.org/>

Waterbird Conservation Regions applicable to the NPS Coastal Network include the New England/Mid-Atlantic Coast and Southeastern Coastal Plain and Appalachian Mountain (SECPAM) Colonial Conservation Regions. The NPS Coastal Network parks included in the New England/Mid Atlantic Region are CACO, FIIS, SAHI, and GATE. The NPS Coastal Network parks included in the SECPAM region are ASIS, GEWA, THST, and COLO.

In its October 24, 2000 draft, the Waterbird Conservation Plans notes the following species as candidates for priority species in the SECPAM region. (Species mentioned are applicable to the NPS coastal Parks are listed) Black-crowned Night Heron, Black Skimmer, Common Tern, Forster's Tern, ?Greater Shearwater, Gull-billed Tern, Least Tern, Little Blue Heron, Roseate Tern, Royal Tern, Sandwich Tern, Tricolored Heron. The Plan notes that coastal wetlands are priority habitats which are critical for feeding habitats for colonial waterbirds, particularly herons, ibises, and storks nesting along the coast. They are also essential habitat for wintering birds of the same species. Much of the threat from development and other human alteration is greatest on the mainland adjacent to the rivers and bays, which affects the quality of the remaining wetland habitat. Coastal beaches line the continental margin through much of the SECPAM region. Beaches include high-energy sandy beachfronts, sandy flats (at inlets and wash over sites), oyster and shellfish bars, and dredge mounds. These are critical nesting habitat especially for gulls, terns and skimmers. Beaches suffer from intense competition with human use, including intrusion, pets, increases in natural and exotic predators and also beach renourishment and stabilization programs. Least terns are noted to be particularly at risk due to frequent disturbance. Islands provide critical nesting and roosting and /or feeding habitat for nearly all species of colonial waterbirds and seabird species. Suitable nesting islands occur in the lakes and inside barrier islands. Herons, ibises, storks, Brown Pelicans, laughing gulls, terns, skimmers and double-crested cormorants use these sites. Given the limited number of these sites, especially in the northern part of the region, their management and protection is essential to colonial waterbirds. Estuaries, especially those with extensive marshes, typically have high productivity. They provide food resources for breeding, migratory and wintering colonial waterbirds. They are complex habitats that include muddy flats, muddy banks, salt marshes, marsh streams and channels, bays and rivers. The Chesapeake Bay, located adjacent to GEWA, TSHS and COLO, is among the largest estuaries in the world. Many estuaries have been affected by development, especially nutrient pollution, but for the most part, remain productive. Under increasing pressure from upland and coastal development, the water quality and food chains of the estuaries need to be preserved for colonial waterbird conservation to be successful in the SECPAM region. In addition, the SECPAM plan noted the Chesapeake Bay as a candidate for listing as an Important Colonial Waterbird Area.

U.S. Shorebird Conservation Plan:

During the past few years, enormous progress has been made in developing national and regional plans for monitoring shorebirds. Shorebirds have been identified as one of four major avian

programs under the newly formed North American Bird Conservation Initiative (NABCI). Several dozen shorebird experts have prepared a U.S. Shorebird Conservation Plan. The U.S. Plan includes a proposed national monitoring program. Regional shorebird plans have also been prepared under the auspices of the U.S. Plan, and each of them calls for regional monitoring programs. Thus, a rich infrastructure, almost undreamed of just a decade ago, now exists for developing and implementing shorebird monitoring programs.

This project was designed to incorporate a broad-based team of stakeholders/collaborators that included local, state and federal agencies, non-governmental organizations, business-related sectors, researchers, educators, and policy makers. The Plan was closely coordinated with the NAWMP and Joint Venture professionals as well as PIF and the NAWCP as they concurrently develop their revised national plans.

The National Shorebird Plan established national and regional goals for the shorebird monitoring program. The national goals are: 1) Statistically valid monitoring of long-term, species-specific population trends 2) More precise estimates of the size of species' total populations 3) Monitoring shorebird use of major staging, migration, and wintering areas in the United States and Canada 4) Ensuring that shorebird population information is effectively integrated into the national bird conservation planning and implementation process.

Goals 1, 3, and 4 can be addressed at major stop-over sites. They require that the surveys be carefully designed so that statistically valid inferences may be made and so that the information derived can be integrated with other major programs being carried out under the North American Bird Conservation Initiative. It is also essential that the surveys at each site be carried out over the long term, not for just a few years.

The general goal of the shorebird survey is thus to monitor numbers of shorebirds at major stop-over sites, with specific survey areas being chosen to include the most heavily used areas at each site and any areas that are of special interest to local managers.

The International Shorebird Survey (ISS) in the eastern and central United States and the Maritimes Shorebird Survey in southeastern Canada have been conducted for more than 20 years and provide a wealth of information about how to survey shorebirds in these areas. Volunteers conduct surveys at over 600 sites in the United States. Cooperators census shorebirds three times monthly during key migration periods at a site selected by the cooperator. There are 28 survey sites within the New York Bight study area, mostly concentrated in the backbarrier lagoons along the New Jersey and Atlantic coasts.

The North Atlantic Planning Region is within the Atlantic Flyway, and encompasses all or part of the following states: Virginia (VA), Maryland (MD), Delaware (DE), New Jersey (NJ), Pennsylvania (PA), New York (NY), Connecticut (CT), Rhode Island (RI), Massachusetts (MA), Vermont (VT), New Hampshire (NH), and Maine (ME). Habitats range from rocky shorelines to sandy bay beaches to tidal mudflats. The major habitat types are: 1) beach front, including high-energy beaches, sandy deltas, rock and gravel shorelines, and high beach/dune; 2) intertidal mudflats lacking vegetation (mudflats and muddy creek banks); 3) vegetated intertidal marshes (dominated by *Spartina cordgrass*); 4) managed impoundments, both brackish and freshwater; 5)

inland habitats (such as forested wetlands and peninsulas that concentrate migrants), as well as managed uplands (airports and pastures).

The North Atlantic region is extremely important for transient shorebirds during both northbound and southbound migrations. The region is critical for the Western Hemisphere population of Red Knots (*Calidris canutus rufa*), which is extremely concentrated in Delaware Bay each spring. It also supports most of the Atlantic Flyway's breeding Piping Plover (*Charadrius melodus*), a federally threatened species. Shorebirds in this region face potential impacts from: 1) recreational disturbances to foraging and nesting birds, 2) oil spills, 3) extraction of resources affecting shorebird food supplies (e.g., horseshoe crabs), 4) habitat loss due to development, 5) predators, 6) contaminants, and 7) habitat management that lacks integration with shorebird needs.

The region includes critical migration sites for Red Knot, and key staging areas for Ruddy Turnstones, Sanderlings, Semipalmated Sandpipers, and Dunlin. Most of the continental population of the endangered Roseate Terns nests on islands off NY and the southern New England states. Other terns, and gulls nest in large numbers and large mixed colonies of herons, egrets, and ibis may form on islands in the Delaware and Chesapeake Bay regions and Long Island

Species of highest priority in this region include Piping Plover, American Oystercatcher (*Haematopus palliatus*), Red Knot, Whimbrel (*Numenius phaeopus*), American Woodcock (*Scolopax minor*), and Eskimo Curlew (*Numenius borealis*). Shorebird populations have been surveyed to varying degrees by states and non-governmental organizations in the North Atlantic region. Shorebird numbers fluctuate widely across seasons and habitats, however, making survey techniques difficult to apply broadly in the region. For many species, data on seasonal shorebird populations in the region are not available.

Section IV. Nationwide Long-term Avian Monitoring Programs

Breeding Bird Survey

The North American Breeding Bird Survey (BBS), which is coordinated by the National Biological Service and Canadian Wildlife Service, is a primary source of population trend and distribution information for most species of North American birds. Several recent summaries of the BBS have been published (e.g., Peterjohn and Sauer 1992, Droege 1990, Droege and Sauer 1988, 1989). The survey unit is a roadside route, which is 39.4 km (24.5 miles) long. An observer surveys the route once each year during the peak of the breeding season, primarily during June although routes in desert regions and some southern states are surveyed during May. The observer stops at 0.8 km (0.5 mile) intervals, and records all birds seen or heard within a 0.4 km radius circle of each stop during a 3-min sampling period. The starting point and direction of each route was randomly located within a degree block of latitude and longitude (Robbins et al. 1986, Droege and Sauer 1990). NPS Coastal Network sites that presently have or have recently had the BBS occurring within their boundaries include COLO (1992; 1996-1999)-along Colonial Parkway, ASIS (1992-present at Chincoteague NWR) and CACO (1989-1999). Also, BBS are located close to THST (1966-present) and FIIS (1966-1972; 1986-1996). Data can be located through the website <http://www.mp2-pwrc.usgs.gov/bbs>. Species data for COLO, ASIS and CACO will be entered into the NPSpecies database. See Appendix 1. for a list of the State BBS Coordinators, State codes and Route codes to obtain species and abundance data.

State Breeding Bird Atlas

Birders in Great Britain and Ireland were the first to format methods and complete an Atlas to their breeding birds. The methods involve dividing an area (state, province, country) into uniform "blocks." The blocks are thoroughly surveyed, and observers note the breeding status of all birds in the area. The data is compiled, and the breeding ranges of all species are mapped. The first Atlas gives biologists baseline data on the distribution of birds, and on the relative abundance of species. Other significant aspects of bird populations can be evaluated when the process is repeated years later. Species' ranges increase or decrease, and new breeding species appear. Many US states have completed, or are in the process of completing, their first Atlases. Atlases have been completed in the following states: New York (FIIS, GATE, SAHI), New Jersey (GATE-Sandy Hook Unit), and Maryland (ASIS, THST).

Coordinated by the National Audubon Society of New York State (NASNY), the Atlas 2000 is a multi-year effort to locate bird species and document their breeding habitats in New York. This is a replication of the first Breeding Bird Atlas that was conducted from 1980 to 1985 and resulted in the publication of The Atlas of Breeding Birds in New York State in 1988.

To accomplish the survey, biologists divided the state into more than 5,000 atlas "blocks," each measuring 5 x 5 kilometers (3 x 3 miles). Regional coordinators assign survey blocks to volunteers and provide them with a handbook of instructions, field data cards and maps of their

blocks. Once assigned to a block, volunteer birders visit each habitat and record each bird species they see or hear. The species lists from the 1980-1985 Atlas for FIIS, GATE and SAHI have been downloaded Excel files and will be entered into NPSpecies in the near future. When the Atlas 2000, is completed, this data can also be entered into NPSpecies. The database can be accessed at <http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/results/index.cfm>. For more information, please contact the Project Coordinator at: fwbba@gw.dec.state.ny.us Table? Lists all the known associated blocks for FIIS, GATE and SAHI

The Atlas of the Breeding Birds of Maryland and the District of Columbia is a publication of the Maryland Ornithological Society. It presents data on 199 species of birds that breed in Maryland and the District of Columbia. Each species account contains information on habitat requirements, distribution, abundance, history, and nesting characteristics. The field observers achieved over 99 percent coverage of the study area and generated over 100,000 records. In addition, The Atlas includes historical distribution data collected since the mid-1800s, nest records collected over the past 100 years, data from breeding bird surveys conducted since 1966, and relative abundance information from minaret data collected since 1983. Mark Hoffman, the MD Atlas coordinator has been contacted to obtain Maryland Atlas data at ASIS and THST.

In New Jersey, the state was divided into about 800 blocks, each about 10 square miles. A minimum of 20 man-hours of observation per block was required. Over 88,000 records on 210 species of breeding birds in New Jersey were generated between 1993 and 1996. The censusers have helped to create the largest database on the distribution of New Jersey's Threatened and Endangered birds. This data is also being transferred into the hands of land-use regulators so they can use it to preserve habitat. The Sandy Hook Unit of GATE fell into two discreet blocks and therefore received a minimum of 40 man-hours of observation. This data (species list and breeding status observed) has been obtained from the NJ Atlas data manager in Excel format and will be entered into NPSpecies.

In addition, the Massachusetts Audubon Society is preparing to publish The Massachusetts Breeding Bird Atlas. Bird data maps from the Virginia Breeding Bird Atlas project will be available within a few months. A book will be coming out about the Birds of Virginia that includes the species accounts from the Atlas work as well (pers. communication Larry Lynch, Pres. VA Society of Ornithology). Coordinators of the Atlas are: Richard Banks e-mail: Richard_Banks@USGS.GOV; Roger B Clapp, USGS Patuxent Wildlife Research e-mail Clapp.Roger@NMNH.SI.EDU. In April 2002, Roger Clapp indicated the book might be available in 2003.

Monitoring Avian Productivity and Survivorship Program

The Monitoring Avian Productivity and Survivorship (MAPS) program is a cooperative effort among public agencies, private organizations, and individual bird ringers in North America to operate a network of over 500 constant-effort mist netting and ringing stations during the breeding season (DeSante et al. 1995). MAPS was established in 1989 by The Institute for Bird Populations (IBP) and was patterned to a large extent after the British Constant Effort Sites (CES) scheme operated by the British Trust for Ornithology (Baillie et al. 1986, Peach et al. 1996, 1998). MAPS uses a standardized constant-effort mist-netting protocol at a network of

stations. Each station typically consists of about ten permanent net-sites located opportunistically, but rather uniformly, within the interior eight ha of a 20-ha study area (DeSante et al. 2001a). Typically, one 12-m, 36-mm-mesh mist net is operated at each net site for six morning hours per day, for one day during each of six to ten consecutive 10-day periods. Starting dates vary between May 1 and June 10 (later at more northerly latitudes and higher elevations) and operation continues through the ten-day period ending August 8. All birds captured during the program are identified to species, age, and sex using criteria in Pyle (1997) and, if unmarked, are ringed with a uniquely numbered aluminum ring provided by the U.S. Geological Survey/Biological Resources Division (USGS/BRD) Bird Banding Laboratory or the Canadian Wildlife Service/Bird Banding Office.

Following Peach et al. (1996), productivity indices are calculated as the proportion of young in the catch (number of young individuals captured/total number of aged individuals captured). Annual adult survival rates and adult capture probabilities are estimated from modified Cormack-Jolly-Seber mark-recapture models (Clobert et al. 1987, Pollock et al. 1990, Lebreton et al. 1992) that include a between- and within-year length-of-stay transient model (Pradel et al. 1997, Nott and DeSante in press). These modifications permit estimation of the proportion of residents among newly captured birds and provide survival rate estimates that are unbiased with respect to transient individuals (Pradel et al. 1997).

MAPS protocol (DeSante et al. 2001a) also requires station operators to record the probable breeding status of all avian species seen, heard, or captured at each station on every day of operation using methods similar to those employed in breeding bird atlas projects; and to assign a composite breeding status for every species at the end of the season based on those records. In addition, a station map and standardized quantitative habitat descriptions are prepared each year for each major habitat type contained in the station by means of the MAPS Habitat Structure Assessment protocol (Nott 2000). Finally, MAPS operators are able to enter or import, verify, edit, and submit all their data to IBP by means of MAPSPROG Version 3 (Froehlich et al. 2000, Michel et al. 2000), a specially designed Windows-based computer program distributed free of charge for that purpose by IBP. MAPSPROG has four modules that deal, respectively, with ringing, effort, breeding status, and habitat assessment data. The program includes within- and between-record verification algorithms that substantially improve the quality of the ringing data, particularly age and sex determinations. Importantly, it allows the persons who actually collect the data to also verify and edit them. Moreover, this process can be carried out during the field season, thereby allowing station operators to learn from their errors in a very timely manner.

The Program was endorsed in 1991 by the Monitoring Working Group of the Neotropical Migratory Bird Conservation Initiative, Partners in Flight (PIF), and the Bird Banding Laboratory, and a four-year pilot project (1992-1995) was approved and funded by the U.S. Department of the Interior (USDI) to evaluate the utility and effectiveness of the Program for monitoring demographic parameters of landbirds. During the ensuing four-year pilot study, the program grew from 178 to 391 stations. A general evaluation of the pilot project (DeSante 1996, 2000, DeSante et al. 1999) and an evaluation of the statistical properties of the data (Rosenberg 1996, Rosenberg et al. 1999, 2000) were completed in 1996. A review of the Program and of the evaluations of the pilot project was completed by a panel assembled by USGS/BRD (Geissler

1996). The review concluded that: (1) MAPS is technically sound and is based on the best available biological and statistical methods; (2) it complements other landbird monitoring programs such as the North American Breeding Bird Survey (BBS) by providing useful information on landbird demographics that is not available elsewhere; and (3) it is the most important project in the nongame bird monitoring arena since the creation of the BBS.

MAPS thus became an "established" monitoring program in 1996 and continued to grow from 424 stations in 1996 to about 507 stations in 2000, the ninth year of standardized operation. The substantial growth of the Program was caused in part by its endorsement by PIF and the involvement of various federal agencies in PIF, including the USDI National Park Service and the Fish and Wildlife Service. MAP programs are occurring at CACO and Ft. Tilden in GATE. Other MAP stations are located close to SAHI and FIIS. The most recent MAPS data for CACO has been entered into NPSpecies. Data for GATE has been requested from MAPS to be entered into NPSpecies.

The Christmas Bird Count:

The CBC began over a century ago in order to determine winter distributions of various bird species. CBC is used to monitor the status of resident and migratory birds across the Western Hemisphere. Volunteer birders of all skill levels from all 50 states, every Canadian province, parts of Central and South America, Bermuda, the West Indies, and Pacific islands count and record every individual bird and bird species seen during one 24-hour calendar day in late December. Each group has a designated circle 15 miles (24km) in diameter - about 177 square miles - where they try to census as much ground as possible within a day. Count results are available at <http://www.audubon.org/bird/cbc>. Historic and current count circles cover all or a portion of the following NPS sites: CACO, FIIS, GATE, ASIS, COLO, GEWA. Data is available for historic and current count circles located close to THST and SAHI. Table ? lists locations for each CBC conducted in or near each Coastal and Barrier park, the year(s) that the CBC was conducted, latitude/longitude coordinates for each CBC and the circle ID for querying the Audubon CBC database. The species lists and associated abundances for all the parks have been downloaded Excel files and will be entered into NPSpecies in the near future.

Mid-Winter Aerial Survey Data

Since 1955, state biologists for the entire Atlantic coast have conducted an annual midwinter aerial waterfowl survey. Waterfowl counts are done over all water areas that traditionally have had waterfowl using the habitat including many NPS sites. State biologists usually flying in USFWS planes conduct these surveys. However, this database has some limitations. Although, the USFWS maintains the database, but they combine data for the whole state and can not usually give data from specific areas. Also, it is usually difficult to get data for specific areas as the plane is going 100 miles an hour and much of the data becomes grouped for larger areas and the data may have limited value locally, because of the tremendous variability in waterfowl movements and other factors that affect waterfowl numbers (pers. communication Matthew Perry at PWRC). However, it is possible to request data for specific areas several months in

advance of the next year's survey, which occurs in January. The state waterfowl biologist for the areas of interest should be contacted to request specific area surveys.

National Wildlife Refuge Data

All waterbirds, including waterfowl, are counted at the refuges every two weeks and at the management area monthly. The counts show the importance of salt marsh habitats to waterfowl year round and the seasonal occurrence of waterfowl species at each refuge. Several of the Coastal Network sites have refuges within their boundaries or adjacent/nearby their boundaries. ASIS includes Chincoteague NWR and GATE includes Jamaica Bay NWR. The William Floyd Estate that is part of FIIS is located near (approximately 2 miles) the Wertheim NWR and SAHI is located near Oyster Bay NWR. Monomoy NWR is located adjacent to the southern end of CACO. Data for Chincoteague NWR and Jamaica Bay NWR is being requested for entry into NPSpecies.

Monomoy NWR is a federally designated Wilderness Area. Monomoy NWR and Chatham's South beach (also adjacent to CACO) were named Important Bird Areas by the Massachusetts Audubon Society. These areas contain essential habitat for one or more species of breeding, wintering or migrating birds. The predominant habitats are very similar to CACO including coastline, dunes, tidal flats and some fresh-brackish wetlands. Monomoy and South Beach support breeding populations of the federally listed Piping Plover and Roseate Tern, and state-listed Northern Harrier, Common Tern and Least Tern. These sites also support many high conservation priority species such as the Snowy Egret, Black-crowned Night Heron, American Black Duck, American Oystercatcher and Willet. Monomoy NWR has a long history of research and monitoring including at least 50 years of tern monitoring, 25 years of International Shorebird Census data and research on Short-eared Owls and Piping Plovers.

Migration Patterns and Winter Ecology of Tundra Swans

The Virginia Department of Game and Inland Fisheries is cooperating with Cornell University and the Atlantic Flyway states of Maryland, Pennsylvania, and North Carolina in a study to better assess the migration patterns and winter ecology of tundra swans. Specifically, scientists are trying to determine where tundra swans breed and what routes they fly to get there; where these swans go in the winter; what kinds of habitats tundra swans use in Virginia; and what their survival rates are in Virginia and the Atlantic Flyway.

Tundra swans have been located on their wintering grounds on the Potomac River in Virginia (GEWA's marshes are located on this river). This area contains shallow tidal-water flats where swans and other waterfowl can feed on submerged aquatic vegetation and associated invertebrates. Many swans stop along the Potomac River and its' tributaries during the fall migration.

Another swan was captured at Hog Island WMA, Virginia in February 2001, which is located across the river from the Jamestown Island of COLO. This area has become an important wintering habitat for migratory waterfowl and other migrating bird species. About 100 swans spent the winter of 2000-2001 at Hog Island WMA.

Bibliographic Database to North American Waterfowl and their Wetland Habitats

PWRC maintains an extensive Bibliographic Database to North American Waterfowl and their Wetland Habitats. This task is designed to provide easy and complete access to this extensive literature, especially the historical and unpublished sources. It is intended to benefit researchers in the design of new studies and preparation of comparative analyses, and to facilitate interactions between partners working jointly on research and management projects.

Colonial Waterbird Surveys

USFWS Coastal colonial breeding waterbird surveys have been conducted regularly since 1975 through the Maine to Virginia Colonial Waterbird Survey (Erwin and Korschgen 1979). Also, federal coastal waterbird atlases were published for the Atlantic coast of the northeastern United States (Maine to Virginia) for 1977 and 1984-1985, and an atlas is now being compiled for 1994-1996. Data from this project has been obtained and will be added to the NPSpecies database and the NPMetadata Catalog.

Database of Colonial Waterbird Surveys

This database is made possible by the participation of monitoring partners throughout the Americas, who conduct surveys of waterbirds and voluntarily contribute their data to this centralized location. As of May 2002, this database contains data from the coastal surveys conducted in the mid-1990s from Maine to Georgia, funded by the US Fish and Wildlife Service, in addition to information published in a number of colonial waterbird atlases in the United States and Canada. In the near future, data from the Cornell Waterbird Register and the US Fish and Wildlife Service-sponsored Great Lakes waterbird surveys will become available. Over time, the utility of the database will grow, as partners throughout the Americas contribute data. This data has been obtained and will be entered into NPSpecies and the Metadata Catalog. To access data regarding specific sites within a C&B park go to: <http://www.mp2-pwrc.usgs.gov/cwb/>. Currently, the I&M Program is working with Melanie Steinkamp, Director of the Waterbird Program, to obtain specific site locations with all waterbird species identified at each site and other associated data for each park from this very large database.

Breeding Bird Census

The former U.S. Bureau of Biological Survey initiated the concept of a Breeding Bird Census (BBC) in 1914. The Biological Survey initially administered these censuses. Between 1937-1984, the National Audubon Society sponsored the program and published the annual results in *American Birds* and its predecessor publications. Since 1985, the Cornell Laboratory of Ornithology has administered the BBC. The results were not published for several years during the 1980s, but have appeared as a supplement to the *Journal of Field Ornithology* during the 1990s.

The Breeding Bird Census program is based on individual study plots established within a single habitat type. Standardized methods are followed to collect data on the avian and vegetative

communities. Over a period of years, these data can provide insight into the changes occurring in the breeding bird populations within these communities.

The exact location of each BBC plot and the habitat studied within the plot are at the discretion of the individual cooperator(s), although they must meet certain requirements established by the program. No random selection process is involved in the establishment of their locations. Most plots are located at sites that are relatively free from disturbance, such as parks, nature preserves, and wildlife refuges, although a number have also been established on private property.

The exact size and dimensions of the study plot are also at the discretion of the cooperator(s), and may be influenced by the amount of effort required to obtain complete censuses. However, minimal plot sizes are recommended by the BBC of 10 hectares in closed habitats and 40 hectares in open habitats, although some plots may be smaller than these recommendations

At the initiation of each study plot, quantitative data are collected to describe the species composition and vegetative structure of the community. Standard methodologies are followed so the data are comparable between plots (James and Shugart 1970). Subsequent changes in the structure and composition of the vegetative community are frequently described in subjective narratives, although some plots will repeat the quantitative surveys at periodic intervals.

The BBC employs the spot-mapping methodology to estimate population densities for each species present in the study plots (Robbins 1970). Minimums of 8 visits spaced throughout the breeding season are normally required each breeding season to accurately map the territories of all species. Rules for interpreting these spot-maps are also defined in this methodology, although these rules do not completely eliminate all of the individual interpretation of the data.

The BBC results are provided as the total number of territories for each species present in each plot during each year. These results are also standardized as the number of territories per 40 hectares for species with 3 or more territories on a plot. The numbers of nests and fledglings recorded during the censuses are also provided for each species. A list of species considered to be "visitors" is provided separately from the list of breeding species. In the published accounts, a remarks section provides brief comments concerning the importance of the year-to-year changes and long-term trends for species on the plots, as well as other information relevant to the censuses. Portions of the BBC database have been computerized; however, attempts to access this database online have been unsuccessful. At this time, it is uncertain whether any C&B parks are utilizing the BBC.

A number of factors could potentially limit some of the uses of BBC data. At larger geographic scales, the most important question concerns how representative are the BBC plots of the habitats and avian communities in an area? Whether or not the temporal changes in the bird communities are representative of the trends of the entire area is also questionable. The factors used to select each site are largely unknown, but may include ease of access, proximity to the observer's residence, or the fact that the sites are known to be "good birding areas". Hence, using BBC data to draw conclusions beyond the boundaries of the individual plots may be rather tenuous.

Please refer to the website: <http://www.im.nbs.gov/birds/bbc.html> for a detailed account of factors which need to be considered when examining data from individual plots; examining composition and trends of bird populations.

For more information about the BBC, instructions for establishing BBC plots and possible use within the C&B parks, or to obtain instructions and data forms, please contact: James D. Lowe, Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, New York 14850

The North America Raptor Monitoring Strategy

The USGS Forest and Rangeland Ecosystem Science Center, Snake River Field Station, and Boise State University, Raptor Research Center, along with many collaborators, are developing a strategy for monitoring diurnal raptors throughout North America. Development of a continental monitoring program for raptors was initiated in July 1996 during the North American Raptor Monitoring Workshop held in Boise, Idaho. Currently species accounts for most diurnal North American raptors are being developed.

The result of this effort will be a North American Raptor Monitoring Strategy (NARMS) consisting of individual species accounts and a synthesis identifying the best techniques and most efficient approaches for long-term monitoring. The species accounts will include details to support conclusions about how well each species currently is monitored, by what methods, in what areas, and at what seasons of the year. The integration of that information will reveal situations in which groups of species are well monitored by a given method (e.g., the Breeding Bird Survey), in a certain area (e.g., the Upper Mississippi Valley), and/or within a particular season (breeding, migration, winter). The Strategy will include recommendations for general and specific improvements in study design, sampling, and data analysis. Ultimately, NARMS will provide a sound scientific and statistical basis for monitoring raptor populations based on comprehensive, up-to-date information. Wildlife and land managers will be able to use the strategy as a basis for deciding what long-term monitoring to undertake, and for conclusions about the current status and trends of many species. The Strategy will alert managers and policy makers to the paucity of available information in many cases, and the need for new survey and monitoring methods. The strategy is scheduled to be completed in the near future. The principal investigators for NARMS are: Mark R. Fuller mfuller@eagle.boisestate.edu; Robert N. Lehman blehman@cnr.colostate.edu; Kirk K. Bates kbates@eagle.boisestate.edu. For more information about NARMS go to website: <http://srfs.wr.usgs.gov>.

National Mid-winter Bald Eagle Surveys

The Snake River Field Station (SRFS) coordinates the Midwinter Bald Eagle Survey, in which several hundred individuals count eagles along standard, non-overlapping survey routes. Nationwide counts of eagles were coordinated by the National Wildlife Federation from 1979 until 1992, when the Raptor Research and Technical Assistance Center (now SRFS) assumed responsibility for overseeing the count. Initial objectives of the survey were to establish an index to the total wintering Bald Eagle population in the lower 48 states, to determine eagle distribution during a standardized survey period, and to identify previously unrecognized areas of important winter habitat. In 1986, Millsap (Wildl. Soc. Bull. 14:433-440) reported results of the midwinter survey from 1979 through 1986.

Beginning in 1984, National Wildlife Federation officials asked participants in each state to count eagles along standard routes to provide data on numerical trends. Standard survey routes were defined as clearly described areas where eagles had been observed in the past. Federation guidelines stipulated that standard surveys be conducted by the same number of experienced observers using the same method (e.g., fixed-wing, helicopter, boat, vehicle) at approximately the same time of day each year.

Observers conduct surveys on standard routes during the first 2 weeks of January each year, usually on 1 of 2 target days. Most survey participants are employees of state or federal conservation agencies, but private volunteers also participate in the survey. Coordinators from each state are responsible for organizing local counts, enlisting survey participants, and compiling data to eliminate duplicate sightings and overlapping routes. Sizes of survey routes vary from single fixed points to 150 miles. Twenty-seven states identified and began surveying standard routes in 1986; other states did not begin standard surveys until the mid-1990s. Some states stopped participating in the count in the 1990s. The number of states participating each year has ranged from 38 to 49, and the number of standard survey routes per state ranges from 1 to 80.

The Midwinter Count can be an effective and economical way to monitor long-term changes in Bald Eagle populations. The survey represents a unique source of long-term, baseline population data. Unlike nesting surveys, it provides information on both breeding and nonbreeding segments of the population at a potentially limiting time of year. It also provides an opportunity to monitor modifications or threats to habitat at important wintering areas. The count has become a tradition that will likely continue in many states.

Contact with Peter Nye, NYDEC revealed that no mid-winter bald eagles surveys have been conducted on FIIS, GATE, SAHI due to lack of individual birds found in these areas in the past. The Midwinter survey on ASIS has consistently found non-breeding Bald eagles and recently nesting Bald eagles on ASIS. Both COLO and GEWA have nesting pairs of Bald eagles that are monitored through the Midwinter survey. Information regarding Bald eagle mid-winter surveys and Bald eagle presence at CACO and THST is unknown. More information regarding this survey can be found at: <http://srfs.wr.usgs.gov>. The contact person for this survey is Karen Steenhof, Principal Investigator, ksteenho@eagle.boisestate.edu. State coordinators are listed below:

Massachusetts	Brad Bloget	BRAD.BLOGET@STATE.MA.US	508-792-7270 x152
New York	Peter Nye	penye@gw.dec.state.ny.us	518-478-3053
New Jersey	Larissa Smith	llsmith@gtc3.com	609-628-2103
Maryland	Glenn Therres	GTherres@DNR.STATE.MD.US	410-260-8572
Virginia	Jeff Cooper	jcooper@dgif.state.va.us	540-899-4169

American Peregrine Falcon Monitoring Plan

The American peregrine falcon (*Falco peregrinus anatum*) was removed from the Federal List of Endangered and Threatened Species in 1999, due to recovery. Section 4(g)(1) of the Endangered Species Act requires that a plan be implemented to effectively monitor for not less than 5 years the status of all species that have been recovered and delisted. An American peregrine falcon monitoring plan was then developed by the USFWS in cooperation with State resource agencies, recovery team members and interested scientists and will be carried out in collaboration with Federal, state and private cooperators. The monitoring started in the spring, 2002. Surveys will be conducted every three years, for a total of five surveys. Monitoring will include collection of information on the population trends and nesting success. At the end of each triennial monitoring period, and at the conclusion of the 13-year monitoring program, all the available information will be reviewed to determine whether the status of the falcon is continuing to improve. Falcon territories within each region will be selected and surveyed. A Regional Coordinator will be identified by the USFWS and that person is responsible for coordinating data collection and ensuring that approved survey protocols are utilized within their assigned Region. The C&B Network falls into the designated Eastern Region.

Northern Saw-Whet Owl Monitoring

In 1991, biologists in eastern North America established a network of saw-whet owl banding stations (OWLNET) to monitor the fall migration of this species historically believed to be uncommon on the east coast. The stations are found in southeastern Canada, Wisconsin, Maine, Pennsylvania, New Jersey, and Virginia. Rhode Island

This long-term monitoring program focuses on trapping and banding to document migration movements of Northern Saw-whet owls (*Aegolius acadicus*) in the United States. Banding data is compared to other locations to establish geographic differences in phenology and geographic patterns in age/sex class structure. Other efforts will improve the understanding of how saw-whet owls utilize barrier island habitats during the winter by assessing winter distribution and density. Currently, this program is run each fall migration on ASIS.

David F. Brinker, an ecologist with the Maryland Department of Natural Resources, created the concept of Project OwlNet. Project OwlNet grew from a series of five cooperating saw-whet owl banding stations spread across Maryland to a growing network of cooperators that is spreading North, West and South across the continent. With this expansion, other North American migratory species of nocturnal owls are being included in OwlNet. Project OwlNet's three primary goals are to support expansion of a network of migrant owl banding stations, advocate the use of relatively comparable netting protocols and improve communication and coordination between owl banding stations in the North America

OwlNet provides the most current resources regarding owl migration research to those interested in this field. The use of similar protocols, allowing diversity for individual projects while maintaining collection of key data, has facilitated increased understanding of Northern saw-whet owl migration at cooperating stations. Their listserv, Sawwhetnet, provides an email forum for discussion of current owl migration events, study methods and techniques.

On their website, <http://www.projectowl.net/org/netproto.htm>, suggested methodologies and protocols advocated by Project OwlNet and the North American Raptor Monitoring Strategy are

discussed. They are designed to produce data for regional analysis of owl migration, while at the same time remaining flexible to the individual's needs. Links to related projects and efforts, as well as a complete bibliography, are being compiled for reference and further research. Additional materials and information may also be available simply by contacting Project Owl-net at Sawwhetnet@aol.com.

Table 2-2. Lists national avian monitoring programs located in or close by at least one CBN park.

Table 2-2. National Avian Monitoring Programs Located in or near CBN Parks

Program	CACO	FIIS	GATE	SAHI	ASIS	THST	GEWA	COLO
Breeding Bird Survey	X	X			X	*X		X
Breeding Bird Atlas	*X	X	X	X	X			**X
Monitoring Avian Productivity and Survivorship	X	*X	X	*X				
Christmas Bird Count	X	X	X	*X	*X	X	X	X
Nat'l Wildlife Refuge Counts	X	*X	X	*X	X			

* located in close proximity to park

** to be completed in near future

Section V. Monitoring Programs within the Coastal and Barrier Network

Section V.1. Landbirds/Neotropical Migrants

Landbirds refer to several groups of birds including many passerines and some gamebirds. Many landbirds are neotropical migrants. Landbirds are excellent indicators of the effects of local, regional, and global environmental change in terrestrial ecosystems because of their high body temperature, rapid metabolism, and high ecological position on most food webs. Furthermore, their abundance and diversity in virtually all terrestrial habitats, diurnal nature, discrete reproductive seasonality, and intermediate longevity facilitate the monitoring of their population and demographic parameters.

Several large-scale monitoring programs that provide annual population estimates and long-term population trends for landbirds are already in place on this continent. They include the North American Breeding Bird Survey (BBS), the Breeding Bird Census, the Winter Bird Population Study, and the Christmas Bird Count (see detailed description of programs above). Analyses of data from several of these programs, particularly the BBS, suggest that populations of many landbirds, including forest-, scrubland-, and grassland-inhabiting species, appear to be in serious decline (Peterjohn et al. 1995). Indeed, populations of most landbird species appear to be declining on a global basis.

Landbirds that have both a high percentage of their total population in the Northeast and are undergoing population declines include Henslow's sparrow (*Ammodramus henslowii*), golden-winged warbler, worm-eating warbler, cerulean warbler, Louisiana waterthrush, whip-poor-will (*Caprimulgus vociferus*), and Canada warbler. Several of these species are already listed as endangered or threatened by one or both states. Bird species breeding in successional habitats have declined in the Northeast even more than have forest-nesting species. One group of declining successional nesting species of particular interest is grassland birds that are discussed below (Sect.)

Many landbirds are also neotropical migrants. Neotropical migrant refers to those migratory bird species that nest in North America north of the U.S.-Mexico border and Caribbean, and winter in the Neotropical region south of the continental United States. Recently, many species within this group have undergone significant population declines, primarily due to loss or fragmentation of breeding habitat in the U.S. and Canada. In eastern North America, where the best information is available, breeding surveys indicate that 44% of Neotropical migrant species have significantly declined either over the long term (1966-1988) or the short term (1978-1988), or both.

Although the focus of research and conservation efforts for neotropical migrants has been on breeding and wintering grounds, habitat used during migration may be equally important to the survival of a species population. Migrating birds following "programmed" pathways must be

able to satisfy energy requirements, avoid predators, and minimize environmental stress during stopovers.

There is a paucity of information regarding the stopover ecology and habitat requirements of neotropical migrant landbirds along the whole East Coast. Many of the habitats within the C&B Network may provide significant roosting, foraging and resting sites for these birds.

In response to neotropical migrant declines, "Partners in Flight - Aves de las Americas," was initiated in 1991 (Finch and Stangel 1992). The major goal of Partners in Flight (PIF) is to reverse the declines in neotropical migratory birds through a coordinated program of monitoring, research, management, education, and international cooperation.

Landbirds have been selected by the NPS to receive high priority for monitoring. As one of the major cooperating agencies in PIF, the NPS has defined its role in the program to include the establishment of long-term avian monitoring programs at NPS units using protocols developed by the Monitoring Working Group of PIF. Currently, there are no known C&B parks working directly with PIF to establish long-term avian monitoring programs.

ASIS

Table 2-3. Landbird Inventories Conducted at ASIS

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>North End</i>	<i>1977</i>	<i>B</i>	Ganter, Janet E., Martin, Elwood M. 1977. Observations on summer bird populations on the north end of Assateague Island National Seashore.
<i>Unk</i>	<i>1983</i>	<i>B</i>	Maryland Ornithological Society, Inc. 1983. Maryland Breeding Bird Atlas.
<i>Chincoteague</i>	<i>1983</i>	<i>B</i>	Virginia Society of Ornithology. 1983. Virginia Breeding Bird Atlas.
<i>Unk</i>	<i>1987</i>	<i>W</i>	Ricciardi, Sue. 1987. Maryland Mid-Winter Bird Survey.
<i>Unk</i>	<i>1990</i>	<i>U</i>	Bashore, Terry L. 1990. Upland Bird Survey.
<i>Unk</i>	<i>1990</i>	<i>U</i>	Hoffman, Mark L. 1990. Assateague Island Bird Observations.
<i>Backdune Pine Stands</i>	<i>1980</i>	<i>U</i>	Steiner, Alan John. 1980. Avian distribution patterns in the backdune pine forest stands of Assateague Island, Virginia. University of Massachusetts.
<i>Unknown</i>	<i>1991,92</i>	<i>M</i>	McCann, Jim. 1991, 1992. A Comparison of the Fall Density of Neotropical Migrant Landbirds on Assateague Island and mainland Worcester County, Maryland. (1992 is a progress report)

Monitoring Programs Conducted at or near ASIS

Breeding:

BBS

The BBS is conducted on the Chincoteague NWR end of ASIS lists 76 species of passerines found within its boundaries including Henslow's Sparrow and Sedge wren that are listed on MD DNR as Threatened.

Wintering:

Winter Bird Survey

The Winter Bird Survey was developed in Maryland by Danny Bystrak dbystrak@aol.com. The goal of this survey is to create standardized maps of the relative abundance of wintering birds in Maryland using transects. The project was systematically completed over the course of 6 winters, resulting in the publication of both contoured winter distribution maps and atlas style dot maps. The publication has GIF formatted color maps of the winter distribution of each of the species recorded in Maryland. It is noted that this technique provides an accurate picture of the winter distribution of birds in a region and will work well in areas with high volunteer labor pools. Attempts to contact Danny Bystrak to determine if this survey included any portions of ASIS have been unsuccessful. However, conversation with Mark Hoffman at MD DNR revealed that this data is available through MD DNR. This data was requested from Mr. Hoffman and will be entered into the NPSpecies database and Metadata Catalog when received.

Migratory:

Neotropical Migrant Songbird Study

The NPS NRBIB lists a neotropical migrant songbird study published by Sarah Mabey in 1993 (ASIS #7728). However, it is unknown if this was a long-term monitoring program. Currently, no long-term monitoring programs for passerines on ASIS are being conducted through the National Park Service (pers. communication, Carl Zimmerman).

CACO

Table 2-4. Bird Inventories Completed at CACO (Various Bird groups)

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Unk</i>	<i>1976</i>	<i>U</i>	Nikula, B. 1976. A checklist of the birds of Cape Cod, Massachusetts. Cape Naturalist. 5 4.
<i>Unk</i>	<i>1985</i>	<i>U</i>	Nikula, B. 1985. A checklist of the Birds of Cape Cod, Massachusetts. pages (Unpublished).
<i>Herring River</i>	<i>1987</i>	<i>U</i>	Nikula, Blair. 1987. An Avian Census of the Herring River, Wellfleet, Massachusetts. January 1986. Report Appendix 4, pp. 151-162. Pages ? in Roman, Charles T. An Evaluation of Alternatives for Estuarine Restoration Management: The Herring River Ecosystem (Cape Cod National Seashore). National Park Service Cooperative Research Unit, Center for Coastal and Environmental Studies, Rutgers - The State University of New Jersey, New Brunswick, NJ 08903.
<i>Unk</i>	<i>1990</i>	<i>U</i>	Jones, Kyle. 1990. Bird Inventory, Cape Cod National Seashore.

Monitoring Programs conducted at or near CACO

Breeding:

BBS, BBA, Audubon Society

In addition to the breeding landbird data collected from the BBS and BBA programs, the Wellfleet Audubon Society is located near to CACO and maintains a year-round bird species list.

Programs, which are involved with, inventory and developing breeding bird monitoring protocols at CACO are the following:

MAPS

MAPS at CACO is conducted in three habitats (oak forest, pitch pine forest and pitch pine scrub) and at sites adjacent to low and high residential density to determine population size, annual

productivity and inter-annual survival. This project was initiated in 1999 and will continue through 2003.

Plot Counts

Variable circular plot counts are being used to monitor the distribution, abundance and habitat association of landbirds at CACO. Curtis Griffin, PhD and his students from the University of Massachusetts are conducting this work. This work was initiated in 2001 and will continue through 2002. Any inventory data from 2000 will be entered into the NPSpecies database.

Wintering:

CBC, Wellfleet Audubon

Wintering landbird data for CACO can be found through the CBC conducted at CACO and the Wellfleet Audubon Society that maintains a year-round bird species list

Migratory:

No known long-term monitoring programs focusing on migratory landbirds is conducted at CACO.

COLO

Table 2-5. Bird Inventories at COLO (Various Bird groups)

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Throughout Park</i>		<i>U</i>	Roye, Ralph R., Russell, Richard. No Date. Birds That Occur in the Park All Year Round.
<i>Throughout Park</i>		<i>U</i>	Beaman, Ron, Delara, Willard. 1985. Birds of Colonial National Historical Park. National Park Service, Yorktown, Virginia.
<i>Williamsburg</i>		<i>W</i>	Williamsburg Bird Club. 1986. Analysis of local bird data as of February 1986 for Williamsburg, James City County, York County, and Hog Island. Williamsburg Bird Club, Williamsburg, VA.

Also refer to faunal inventories and rare, threatened and endangered inventories that include bird species in Appendix 1., Tables 1&2.

Monitoring programs conducted at or near COLO

Breeding:

BBS

It is important to note that the most recent Breeding Bird Surveys (approximately 1992-present) at COLO have been conducted by Dana Bradshaw of The Center for Conservation Biology at the College of William and Mary. His work is a continuation of surveys that have been conducted since 1966 along the Colonial Parkway between Yorktown and Jamestown Island. An average of about 65 species were recorded annually over the past several year. New additions to the survey include the Bald Eagle and Double-crested cormorant in 1999. Also that year, it was noted that the prairie warbler and Kentucky warbler were absent relative to previous surveys.

BBA

Wintering:

CBC

Migratory:

No known long-term monitoring programs focusing on migratory landbirds is conducted at COLO.

GEWA

Table 2-6. Bird Inventories at GEWA (Various Bird groups)

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Throughout Park</i>	<i>1970</i>	<i>U</i>	Author unknown. 1970. Survey of vertebrates, George Washington Birthplace National Monument. National Park Service, Washington's Birthplace, VA.
<i>Throughout Park</i>	<i>1985</i>	<i>U</i>	Johnson, E. 1985. Seasonal checklist of birds, George Washington's Birthplace.
<i>Unknown</i>	<i>1986</i>	<i>U</i>	Author unknown. 1986. Birds of Westmoreland County, VA. Westmoreland Bird Club.
<i>Unknown</i>	<i>1989</i>	<i>U</i>	Author unknown. 1989. Joint field trip of Westmoreland Bird Club and George Washington Birthplace National Monument. National Park Service, Washington's Birthplace, VA.
<i>Throughout park</i>	<i>1989</i>	<i>U</i>	Johnson, E., Johnson, S. 1989. Bird sightings at George Washington Birthplace.
<i>Throughout Park</i>	<i>1995</i>	<i>B</i>	Author unknown. 1995. Eagle nests [in the vicinity of George Washington Birthplace National Monument]. National Park Service, Washington's Birthplace, VA.

Monitoring programs conducted at or near GEWA

Very little monitoring has occurred within this site aside from the recent CBC (wintering) and possibly BBA (breeding) work.

THST

The only known bird list for THST was compiled in 1994. Contact with the BBA and BBS coordinators has been attempted to determine if data within THST has been collected. No long-term passerine monitoring programs initiated by NPS have been known to occur at THST.

FIIS

Table 2-7. Bird Inventories of FIIS (Various Bird groups)

Location in Park	Year(s)	Status	Bibliography
Central FIIS	1959-66	U	Goodman, R. 1966. Birds observed on central Fire Island, 1959-1966. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 6 pp.
Throughout Park	1958-1966	W	Cooley, A. 1966. Central Suffolk County Christmas bird count 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 27 pp.
FIIS Light Station	1969	U	U.S. Department of Interior, National Park Service, Fire Island National Seashore. 1969. Bird banding at Fire Island Light Station, 1969. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 6 pp.
FIIS Light Station	1970	M	U.S. Department of Interior, National Park Service, Fire Island National Seashore. 1970. Bird banding at Fire Island Light Station Spring 1970. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 3 pp.
Unknown	1970	U	U.S. Department of Interior, Fish and Wildlife Service. 1970. Bird band recoveries on Fire Island. Unpublished, U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. 3 pp.
Throughout Park	1972	Unk	Buckley, P.A. 1972. Preliminary check-list of the birds of the Fire Island National Seashore area. U.S. Department of Interior, National Park Service, Office of Natural Science, Washington, DC.
Unknown	1972	Unk	U.S. Department of Interior, National Park Service, Fire Island National Seashore. 1972. Checklist to the birds of the Fire Island National Seashore. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 1 p.
Unknown	Unk?1972	B	U.S. Department of Interior, National Park Service, Fire Island National Seashore. No Date. Some summer birds on Fire Island. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 1 p.
FIIS Lighthouse	1983	M	Smith, C.R., Ford, D., Farber, L., Litwin, T. 1983. Habitat use and foraging behavior of migrating songbirds in spring and fall at the Seatuck National Wildlife Refuge, Long Island and at Fire Island Light. Unpublished, Seatuck Research Center, Cornell University, Islip, NY.
Unknown	1985, 88,89-93, 95	B	No Author. 1985,1988, 1989, 1990, 1991, 1992, 1993, 1995. June Bird Count.
Throughout FIIS	1999		Mitra, S., Putnam, J. 1999. Birds of Fire Island National Seashore.

Monitoring Programs conducted at or near FIIS

Breeding:

In addition to the BBA, a MAPS program is conducted at East Islip, which is located on Long Island across Great South Bay from FIIS.

Wintering:

CBC

Historically, CBC's were completed on FIIS from 1963-1971 and on the Atlantic Ocean offshore of FIIS from 1944-1975. Currently, the Captree CBC includes the western end of FIIS. It has been conducted yearly since 1972. It is important to note that this data may include land outside of FIIS boundaries.

Migratory:

Mist-netting at Lighthouse Tract on FIIS

Previous research relating to passerines includes mist-netting conducted by P.A. and F. Buckley between 1969-1972 at the undeveloped Lighthouse Tract on FIIS. Bird species and abundance was recorded. This data is unpublished at this time. A follow-up study (1998-2001) was recently completed by P.A. and F. Buckley. Bird species richness and abundance will be compared to the prior study. Land bird species from these studies have been entered into NPSpecies from a bird species list compiled by Shoai Mitra and John Putnam. When these studies are published, they will be entered into the Metadata Catalog. In relation to this study, Howard Ginsberg used these mist-netted birds to determine if they are potential vectors of Lyme disease.

Neotropical Migrant Point Counts in the Federal Wilderness Area

During the summer of 2001, neotropical migrant point counts (10 points with three visits) were conducted in the Federal Wilderness Area by Ernie Taylor, FIIS Resource Manager. The intent of the project was to continue monitoring these points on a yearly basis. The project has been set up for repetition since latitude/ longitude points were taken to develop a GPS layer. The 2001 data was obtained except for the latitude/longitude points, which it is understood, are with staff at FIIS (pers. communication E. Taylor) and will be entered into NPSpecies.

No current or historical passerine monitoring programs are known to have occurred at the William Floyd Estate.

GATE

Jamaica Bay's and Staten Island's geographic locations act to concentrate marine and estuarine species including migrating landbirds. These migratory species are further concentrated by the surrounding urban developed land into the remaining open space. Jamaica Bay and Breezy Point support seasonal or year-round populations of approximately 120 species of birds of special emphasis which are federal or state-listed species.

Maritime holly forests that occur at Sandy Hook are important as roosting and nesting locations for a variety of birds, and include historical nesting by great blue heron, historical nesting and present roosting by black-crowned night-heron (*Nycticorax nycticorax*), and nesting by several pairs of osprey and several species of passerines.

Table2-8. Bird Inventories of GATE (Various Bird groups)

Location in Park	Year(s)	Status	Bibliography
<i>Sandy Hook</i>	<i>1975</i>		N.A. 1975. Second annual meeting March 25, 1975, Sandy Hook, New Jersey, bird species count. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Sandy Hook Unit, Highlands, NJ. 1 p.
<i>Sandy Hook</i>	<i>?</i>	<i>U</i>	Anonymous. No Date. The birds of Sandy Hook. ?Gateway National Recreation Area, Natural Resource Management Office, Sandy Hook Unit, Highlands, NJ, ?Highlands, NJ.
<i>JBWR</i>	<i>1976</i>	<i>U</i>	Davis, T.H. 1976. The birds of Jamaica Bay Wildlife Refuge. Kingbird 26(1):11-22. No Title.
<i>Sandy Hook</i>	<i>1976</i>	<i>B</i>	Wander, Wade. 1977. Breeding birds of Sandy Hook - 1976. New Jersey Audubon. Occasional Paper No. 129. 3 5 & 6: 84 - 90.
<i>JB National Recreation Area</i>	<i>1979</i>	<i>U</i>	Burger, J. 1979. Avian use study of Jamaica Bay National Recreation Area, Progress Report II. Unpublished, Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, NJ. 22 pp.
<i>Unknown</i>	<i>1979</i>	<i>B</i>	Post, Peter W. 1979. Survey of selected avian species breeding at Gateway National Recreation Area, New York/New Jersey, 1979, with recommendations for management. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Brooklyn, NY.
<i>Staten Island</i>	<i>1979</i>	<i>U</i>	Siebenheller, Norma, Siebenheller, Bill, Fischer, Howie. 1979. Birds of Staten Island.
<i>Floyd Bennett Field</i>	<i>1986</i>	<i>U</i>	Anonymous. 1986. Birds of Floyd Bennett Field. Gateway National Recreation Area, National Park Service, US Department of the Interior.
<i>Floyd Bennett Field</i>	<i>1989</i>	<i>B</i>	Lent, Richard A., Litwin, Thomas S. 1989. Bird-habitat relationships as a guide to ecologically-based management at Floyd Bennett Field, Gateway National Recreation Area. Part I, baseline study. Seatuck Research Program, Cornell University Laboratory of Ornithology, P.O. Box 31, Islip, NY.
<i>JBNWR</i>	<i>1991</i>	<i>U</i>	Jamaica Bay Wildlife Refuge NPS staff. 1991. B3 record (Birds) at Jamaica Bay Wildlife Refuge
<i>Floyd Bennett Field</i>	<i>1994</i>	<i>U</i>	Ferraro, Haley, Bourque, Ronald, Bourque, Jean, Cook, Robert. 1994. Birds of Floyd Bennett Field.
<i>JBNWR</i>	<i>1996</i>	<i>B</i>	Davis, Thomas H., Taft, David, Riepe, Don. 1996. Birds of the Jamaica Bay Wildlife Refuge. Gateway National Recreation Area, National Park Service, US Department of the Interior, Brooklyn, NY.

Monitoring Programs conducted at or near GATE

Breeding:

BBA

Data from the New York BBA has been obtained and will be entered into NPSpecies and the Metadata Catalog. Once data from NJ's BBA is obtained for Sandy Hook, it will also be entered into NPSpecies.

MAPS at Fort Tilden

Data from this project has been requested from The Institute for Bird Populations data manager and will be entered into NPSpecies and the Metadata catalog when obtained.

Breeding Birds at Floyd Bennett Field:

Known historical breeding landbird monitoring programs at GATE include Lent and Litwin's Bird-Habitat Relationships as a Guide to Ecologically-Based Management at Floyd Bennett

Field. Part I was a baseline study that included a "summer" bird species list, habitat covertypes by area and % of total area conducted in 1984. Part II was a post management evaluation that included a "summer" bird species list (1984-1987), herbaceous plant species list and woody plant species list (1984-1987). This data has been obtained and will be added to NPSpecies and the Metadata Catalog.

In addition, a paper on the Breeding Birds of Sandy Hook by Wade Wander may have been a long-term monitoring program. This paper is listed in the NPS NRBib.

Wintering and Migratory:

No other known long-term wintering or migratory landbird monitoring programs have recently been completed or are currently being conducted at GATE.

SAHI

Breeding:

BBA and MAPS

For SAHI, the BBA Block 6252A also includes some of Lloyd Harbor which is located to the east of SAHI. Theodore Roosevelt Sanctuary located less than two miles from SAHI conducts a MAPS program.

Wintering:

Northern Nassau County Christmas Bird Count has been conducted since 1954 and includes SAHI. It is important to note that this data may include land outside of SAHI boundaries.

Migratory:

The Theodore Roosevelt Sanctuary also conducts a fall and spring banding station.

Currently, data from the TRS is being compiled to develop an expected bird species list at SAHI. This list will assist cooperating researchers at TRS in completing the first bird species inventory at SAHI.

Section V.2. Colonial Waterbirds

Introduction to Colonial Waterbirds

Colonial nesting marine birds and wading birds including herons, egrets, ibis, gulls, terns, skimmers, and cormorants are important and conspicuous components of coastal ecosystems in the United States. They represent several orders of waterbirds that share in common the trait of typically nesting in colonies, which most likely evolved as a defense against predators. The majority of these species nest along the coast.

Populations of beach-nesting birds, formerly greatly reduced due to coastal development, recreation, market-hunting, and predation, have increased over the last decade, partly in response to greatly increased management and protection. Overall productivity of beach nesting birds, however, remains low due to predation and other factors.

The extensive recreational, commercial, and industrial development along the U.S. coast, with concomitant habitat modification and impacts from oil and chemical spills, dredging operations, water pollution, human disturbances, and predation, have placed waterbird colonies at increasing risk to their survival, especially in the Northeast.

Threats to colonial nesting waterbirds include human disturbance, predation, habitat degradation, and contaminants. Recreational use of bird-nesting islands and beaches during spring and summer breeding season is detrimental to disturbance-sensitive species such as plovers, terns, and wading birds. Nesting populations of colonial waterbirds and piping plovers on sand or gravel beaches are vulnerable during the nesting season to human-caused disturbances such as trampling or destruction of nests from beach-walking, picnicking, boat landings, off-road vehicle use, and disturbance by pets.

Predation is also major problem for waterbird colonies. On beaches, mammalian predators such as foxes, skunks, raccoons, rats, dogs, and cats are a major problem; islands, although generally free from mammalian predation, may be subject to predation by gulls, crows, other birds, and insects.

Degradation of nesting and foraging habitat is a major threat to both island-nesting and beach-nesting species. Attempts to stabilize and control erosion on beaches often result in a loss of natural diversity of beaches and decreased habitat suitability for nesting and feeding plovers.

Increased vegetation and succession on some islands may reduce their suitability for nesting by terns and gulls. Destruction of trees from the guano of nesting and perching double-crested cormorants has reduced the suitability of many nesting islands for herons in Long Island Sound and may affect additional areas as cormorants expand to the south. Competition for nesting sites and predation by gulls results in loss of tern nesting habitat. Contaminants continue to be a major threat to waterbirds, especially those that feed at or near the top of the aquatic food chain where organochlorine pesticides and other contaminants can accumulate at high levels.

While the emphasis for protecting waterbirds has typically been on nesting sites, it is extremely important to better understand and protect important foraging and stopover areas as well.

Because of the high turnover rate in waterbird colonies, all potential and alternate colony sites in appropriate habitat, as well as existing colonies, should be managed and protected.

Although some waterbirds have been counted for decades, numerous survey methodologies have been implemented over different spatial scales, resulting in data sets that cannot be compared.

Too often, monitoring programs have been initiated without any thought given to future data use

Coastal colonial breeding waterbird surveys have been conducted regularly since 1975 through the Maine to Virginia Colonial Waterbird Survey (Erwin and Korschgen 1979). Federal coastal waterbird atlases were published for the Atlantic coast of the northeastern United States (Maine to Virginia) for 1977 and 1984-1985, and an atlas is now being compiled for 1994-1996. Please refer to the Colonial Waterbird in Section ?? for access to this data. Data from this project has been obtained and will be added to the NPSpecies database and the NPMetadata Catalog.

ASIS

Table 2-9. Colonial Waterbird Inventories Completed at ASIS

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Unknown</i>	<i>1985-1987</i>	<i>U</i>	Gates, J. Edward, Brinker, David F., McKearnan, Joan E. 1985, 1986, 1987. Maryland waterbird study - progress report no. 1. University of Maryland, Appalachian Environmental Laboratory, Frostburg, MD. (final report 1994)
<i>Chincoteague</i>	<i>1975</i>		Cross, Robert R. 1975. Virginia Colonial Bird Study.
<i>Unknown</i>	<i>1981</i>	<i>B</i>	Kumer, Jack. 1981. Monitoring of Colonial Breeding Bird Populations.
<i>Chincoteague</i>	<i>1990</i>	<i>B</i>	Williams, Bill, Beck, Ruth A., Akers, Bill, Via, Jerry W. 1990. Longitudinal surveys of the beach nesting and colonial waterbirds of the Virginia barrier islands. Pages 381-388 in Martin, James H. Biota of the Virginia Barrier Islands. Virginia Academy of Science, Richmond, VA.
<i>Throughout Park</i>	<i>2000</i>		No Author. 2000. No Title. Pages ? in Alvear, Elsa M. Distribution and Abundance of Least Terns (<i>Sterna antillarum</i>) at Assateague Island National Seashore, Maryland, 2000.

Species-Habitat Relationships

ASIS encompasses more than 39,000 acres, more than half of which is comprised of oceanic and estuarine waters surrounding the Island. Habitats within ASIS that may be significant for colonial waterbirds are the pristine barrier beach, freshwater impoundments, and extensive tidal saltmarshes. Changing patterns of land use in the watershed of the coastal lagoons of ASIS threatens park water quality and could greatly affect populations of colonial waterbirds. The following species that are found on ASIS are listed on the State of MD's T&E list: Royal tern

(E), Roseate tern (E), Gull-billed tern (T), Least tern (T), Black skimmer (T). Species in Need of Conservation include the American bittern, Least bittern, Black rail and Common moorhen

A study regarding the status and distribution of Colonial Waterbirds in Virginia noted the barrier island/lagoon system of the Eastern Shore (including Chincoteague NWR) as the most important region for the majority of colonial species encountered. In 1993, this region supported 23 of the 24 colonial species found in coastal Virginia and accounted for >70% and 50% of all breeding pairs and colonies, respectively. For 18 of the 24 species, the region supported >50% of the known coastal population. Also, it was noted that three species included in the 1993 survey have colonized coastal Virginia in the 20 years since the broad surveys of the mid-1970's (Custer and Osborn 1977, Erwin and Korschgen 1979). These species include the White Ibis, the Double Crested cormorant and the Brown Pelican. The following species were noted to have declined in coastal Virginia during the last thirty years: Tricolored Herons (coastal population is >50% reduced since mid-1970's); Little Blue herons (drastic decline 1950's-1970's and now found only on seaside of the Eastern Shore); Black-crowned Night Heron (population estimate is 80% reduction since 1975); Gull-billed tern and Black skimmers have dropped to less than 20% to 30% of their population levels in the mid-1970's (Watts and Byrd 1998). No threats to the populations were noted within this study.

Available records since 1976 show that the Maryland portion of ASIS has often supported a breeding population of Least Terns. ASIS provides some of the only natural nesting habitat the species in Maryland. The highest estimated population between 1993 and 2001 was 320 breeding pairs in 1998. As of 2001, the Least Tern breeding population at ASIS was estimated as 92 pairs on the north end and 113 pairs in the ORZ zone. This estimate was determined by an incubation survey conducted by MD DNR staff. Observations indicate productivity is widely variable. Generally, Least Terns arrive late April and nest are active between mid-May through late July.

Monitoring Programs at ASIS

Breeding:

A long-term monitoring Colonial Waterbird program through the state of Maryland has been conducted since 1985. Currently, ASIS staff collect this data for MD DNR that includes species and breeding population estimates. Once this data is obtained it will be entered into NPSpecies and the Metadata Catalog.

CACO

Table 2-10. Colonial Waterbird Inventories of CACO

Location in Park	Year(s)	Status	Bibliography
Unknown	1979	B	Erwin, R. Michael, Korschgen, Carl E. 1979. Coastal Waterbird Colonies: Maine to Virginia, 1977. An Atlas Showing Colony Locations and Species Composition. Coastal Ecosystems Project, Office of Biological Services, Fish & Wildlife Service, U.S. Department of the Interior, FWS/OBS-79/08.
Throughout Park	1994		Brown, Jennifer M. 1994. Species Composition, Migration Chronology, and Habitat Use of Waterbirds at Cape Cod National Seashore. Masters Thesis. Natural Resources Science, University of Rhode Island.
	2001		Hadden, S.W. 2001. Waterbird Inventory and Monitoring: Report on Protocol Implementation and Development at Cape Cod National Seashore. pages (Unpublished).

Species-Habitat Relationships

Least Tern: This bird species usually breeds on the supratidal beach habitat. Least terns have similar nesting requirements to piping plovers, but tend to require wider beaches and use larger areas of sparsely vegetated dunes. Colonies of 6 to 1000 have been found in Massachusetts. Common Terns and Roseate terns both nest on New Island at CACO. Nest searches and counts are conducted. In recent years approximately 1,000 pairs of Common Terns were counted. There appears to be a constant exchange of birds between New Island and Monomoy Island throughout the season and on a yearly basis. In 2001, a total of four pairs of Roseate Terns nested on the southeast corner of New Island; however, no nests successfully fledged chicks.

Peter Trull et. al. conducted several studies of Roseate Terns *Sterna dougallii* around Cape Cod, Massachusetts, during the post-breeding period (July-September) in 1990-1998. Trull noted that keeping pre-migratory staging and roosting areas vehicle free may be the single most important management factor in securing preserved habitats for the endangered roseate tern, as well as the common tern.

Arctic Terns: Three pairs of Arctic Terns have nested on the southwest corner of New Island for 25 years (Trull pers. comm.). Three nests were found in 2001 and monitored throughout the season. However, no Arctic Tern fledglings were ever observed. This site represents the southernmost nesting location of Arctic Terns in the United States.

Black Skimmers: Five pairs of Black Skimmers nested on the sandy interior of New Island. Although a relatively low number, this represents one of only two nesting sites active in the state (the other being Monomoy Island) and the largest colony in the state. It is believed that there was some exchange of pairs between New Island and Monomoy when nests were lost in either location. Only one nest with hatched chicks (three < 1-week-old chicks) was observed. All other nests were lost to unknown causes or never hatched any chicks. No fledglings were ever

observed on the island. New Island is the northernmost nesting location of the Black Skimmer in the United States.

Laughing Gulls: The largest Laughing Gull colony in the state is found on New Island. In 2001, their population estimate was 773 pairs. This colony has stayed relatively constant in size for several years.

Piping Plovers: All piping plover field activities were completed by the Seashore's piping plover biological technicians. See their annual report for details. A piping plover nest location map was created from data in this report.

Other Colonial Nesting Waterbirds: One American Oystercatcher pair was recorded at Jeremy Point. A GPS location was taken for their nest. Nine Great Black-backed Gull pairs were recorded at Wood End/Long Point, and one pair was also observed at New Island. Seventy-five Herring Gull pairs and three Black-crowned Night-heron pairs were also recorded at Wood End/Long Point.

Monitoring Programs at CACO

Cape Cod National Seashore comprises 43,604 acres including dozens of clear, deep, freshwater kettle ponds and tidal, brackish, freshwater wetlands. Besides the BBA, BBS, CBC, the Wellfleet Audubon Society is located near to CACO and maintains a year-round bird species list.

Breeding:

A protocol for monitoring colonial waterbirds within the C&B Parks is currently being developed at CACO. Transect counts are being used to estimate number of nesting pairs at waterbird colonies throughout the park.

Migrating and Wintering:

Monitoring activities for migrating and wintering colonial waterbirds at CACO include fixed site foraging surveys, foraging survey routes, roosting survey routes, and aerial surveys. All aerial surveys were contracted out and performed by Peter Trull.

COLO

Species-Habitat Relationships

COLO habitats include 37 miles of shoreline (34 acres), 55 miles of streams (55 acres)-approximately 24 miles of perennial streams and 30 miles of intermittent streams, 2482 acres of wetlands, 3061 acres of floodplain. The eastern portion of the Parkway parallels the tidal salt water of the York River. Mature deciduous and Loblolly Pine forests bound its salt-marsh tributaries. The western end of the Parkway to Jamestown parallels the brackish James River, crossing several brackish to freshwater creeks and marshes. COLO provides nesting habitat for great blue herons, great egrets and least bitterns.

Although Great blue herons are frequently encountered in the wetlands of eastern Virginia, the species habitat is limited and threatened by development pressures. Additionally, the species colonial nesting habits puts individuals at risk to single disturbances.

Great egrets are near the northern edge of their range in Virginia where they are migratory, although scattered individuals can be found in southeast Virginia and the Eastern shore year-round. Great egrets are considered very rare in Virginia as a breeding species because they are known from only approximately ten colonies in five counties.

There are only thirteen known least bittern breeding sites in just eight counties of Virginia; therefore, this species is considered very rare. In the Jamestown Island Natural Area of COLO, there is a population of least bitterns occupying the herbaceous wetlands. There were estimated to be over thirty individuals living in these wetlands around Passmore Creek during a survey in July 1991.

In its management plan for COLO, the state of Virginia's Division of Natural Heritage notes: Great blue herons and great egrets nest in one of the largest heron nesting colonies in Virginia along Beaverdam Creek. The colony supports up to 500 pair of these two species. An aerial survey over the colony by VDIF observed 405 great blue heron pairs and 65 great egret pairs in the spring of 1994. Peak nesting times for both species are March through May, but colonies are frequently active from February through July. Also, great blue heron colonies are located on Jamestown Island and Swann's Point in COLO. It is noted that great egrets may also be nesting in these colonies. One hundred fifty-five nesting pairs of great blue herons were documented at Jamestown Island and ninety nesting pairs were documented at Swann's Point during a 1994 aerial survey by VDGIF and the College of William and Mary.

Colonial nesting birds pack large numbers of nests into a few, small areas. This makes entire populations vulnerable to a single disturbance. Since herons may eventually kill the trees in which they nest, colony boundaries tend to slowly migrate across the landscape. The Beaverdam Creek colony has migrated from City of Newport News property onto COLO property. This makes the availability of additional nesting habitat around a colony essential to its continued occupation.

It is noted that the greatest threat to great blue egrets and great egrets at COLO is disturbance. Nesting herons and egrets can be extremely sensitive to disturbance from human activity, especially during critical courtship, nest-building, and egg-laying stages of nesting. It is noted that a single disturbance such as forest management activities, construction work, off-road vehicles and, to a lesser degree, hikers, bikers and horseback riders are all activities can cause failure to an entire colony.

The colonies at Jamestown Island and at Beaverdam Creek are not high use areas. However, at Beaverdam Creek, the disturbance from visitors of COLO or Newport News Park still poses a substantial threat. Foraging herons and egrets, which are repeatedly flushed from foraging areas, may have trouble acquiring enough energy to support themselves and their young. Destruction of nesting or foraging habitat by timber harvest or development may also be a threat if land use in either managed area changes.

A general scale, landscape based threat to the natural area is increased development and major road construction in the vicinity but outside the periphery of the natural area. In addition to loss of potential habitat, encroaching peripheral development may cause surface and ground-water problems in the sensitive area, increase the amount of abrupt ectone and further fragment and isolate this natural area.

The principal threat to the least bittern population in the Jamestown Island Natural Area is alteration, destruction of their herbaceous wetland habitat or a substantial increase in visitation to the herbaceous wetlands around Passmore Creek. Least bitterns are difficult to monitor quantitatively because of their secretive behavior. It was noted that the herbaceous wetlands of Passmore Creek and its tributaries should be surveyed for least bitterns annually every July. Active searches from a small boat or canoe and passive searches from a blind or secluded location should be conducted. The observer should note numbers and locations of least bitterns seen and heard as well as any evidence of nesting activity observed.

Habitat conservation zones have been established for this nesting colony as well as conservation zones for some foraging habitat. In the recent past, the heron and egret nesting colony were monitored every three years by VDGIF. The number of nesting pairs, location and extent of the colony were recorded on aerial surveys in early spring.

A study regarding the status and distribution of Colonial Waterbirds in Virginia noted the western shore (includes COLO) and the southside regions were most significant for supporting a large number of great blue heron and great egret colonies. Breeding of the coastal population of double-crested cormorant populations have increased rapidly since first confirmed in 1978. As of 1996, five colonies had been located in coastal Virginia. The following species were noted to have declined in coastal Virginia during the last thirty years: Tricolored Herons (coastal population is >50% reduced since mid-1970's); Little Blue herons (drastic decline 1950's-1970's and now found only on seaside of the Eastern Shore); Black-crowned Night Heron (population estimate is 80% reduction since 1975) Gull-billed tern and Black skimmers have dropped to less than 20% to 30% of their population levels in the mid-1970's (Watts and Byrd 1998). No threats to the populations were noted within this study.

Monitoring Programs at COLO

Breeding:

In addition to VGIF's surveys of great heron/great egret colonies, an annual BBS is conducted along Colonial Parkway.

Wintering:

Annual Williamsburg and Yorktown CBC's continue to be conducted. Data from these programs has been obtained and will be entered into NPSpecies and the Metadata Catalog.

GEWA

Species-Habitat Relationships

The park is comprised of about 551 acres of lands bounded by the Potomac on the north, Pope's Creek estuary in the east and south and private land to the south and west. Habitats that may be significant for Colonial waterbirds include 25 acres of freshwater and brackish marshes and estuaries, 5 acres of Potomac River beaches and dune habitats. A study done regarding the status and distribution of Colonial Waterbirds in Virginia is discussed in the above COLO section (GEWA was also considered part of the Western shore in this study).

Monitoring Programs at GEWA

Breeding:

BBA

The Virginia BBA should be published in the near future. If this data is accessible and pertinent to GEWA, it will be entered into NPSpecies.

Wintering:

CBC

Annual CBC's have been conducted since 1994 at GEWA.

Currently, no long-term monitoring programs focusing on colonial waterbirds are being conducted at GEWA through the National Park Service (pers. communication, Rijk Morawe).

THST

Species-Habitat Relationships

The majority of park acreage falls within the Hog Hole Run sub-basin, which is a tributary of the Port Tobacco River. Hog Hole Run, a perennial stream, lies adjacent to the western boundary of Thomas Stone NHS. Beaver colonies have been established along Hog Hole Run, which have resulted in wetland areas. Some of these wetlands extend into park boundaries and may be utilized by colonial waterbirds.

Two perennial, unnamed streams can be found within the park. The primary sources of water for these streams are springs, seeps, and precipitation. The courses of both streams follow deep ravines; one on the east side of the park, and one adjacent to the Mansion House area. A man made pond, with an area of approximately 1/2 acre, is found near the park entrance. This pond is spring fed, with a small outlet to an intermittent creek.

Monitoring Programs at THST

Breeding:

BBA

The Maryland BBA data may be the only long-term monitoring program recorded breeding colonial waterbirds within THST boundaries.

Wintering:

CBC

The Port Tobacco CBC data may be the only long-term monitoring programs that recorded wintering colonial waterbirds within THST boundaries.

Currently, no long-term monitoring programs focusing on colonial waterbirds are being conducted at THST

FIIS and GATE

Table 2-11. Colonial Waterbird Inventories of GATE

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Throughout Park</i>	<i>1975</i>	<i>B</i>	Cummins, D. 1975. Helicopter survey of nesting birds. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Sandy Hook Unit, Highlands, NJ 1 p.
<i>Sandy Hook</i>	<i>1975</i>	<i>U</i>	Fisher, Martha N. 1976. Waterbird censusing 1976, Sandy Hook Unit, Gateway National Recreation Area, Highlands, New Jersey. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Sandy Hook Unit, Highlands, NJ.
<i>Sandy Hook</i>	<i>1977-?</i>	<i>B</i>	Various Authors. Colonial waterbirds of New Jersey. Summer . Annual report on the distribution, relative abundance and status of the breeding populations of herons, gulls, terns, and skimmers of New Jersey and recommendation for their management. New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Project, Trenton, NJ.
<i>Jamaica Bay, Breezy Point</i>	<i>1977, 78</i>		Post, Peter W. 1978. Summary of bird-banding activities at Gateway National Recreation Area, 1977 and 1978, with recommendations for management of the colonial waterbird colonies at Breezy Point and in Jamaica Bay. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Brooklyn, NY.
<i>Sandy Hook</i>	<i>1983</i>	<i>B</i>	Anonymous. 1983. Report on colonial birds populations at Sandy Hook (1983). Gateway National Recreation Area, Natural Resource Management Office, Sandy Hook Unit, Highlands, NJ.
<i>Unknown</i>	<i>1979</i>	<i>B</i>	Erwin, R.M. 1979. Coastal waterbird colonies: Cape Elizabeth, Maine to Virginia. FWS/OBS-79/10, U.S. Department of Interior, Fish and Wildlife Service, Biological Services Program, Washington, DC. 212 pp.
<i>Throughout Park</i>	<i>?1983-Present</i>	<i>B</i>	Various Authors. Long Island least tern and piping plover survey. New York Department of Environmental Conservation. Stony Brook, NY.

Table 2-12. Gull and Tern Inventories of GATE

Location in Park	Year(s)	Status	Bibliography
Jamaica Bay	1976	B	Felkel, James D., Peterson, Charles D. 1976. A monitoring study of tern and heron colonies in Jamaica Bay, New York.
Sandy Hook	1976	U	Anonymous. 1976. 'Tern Watch' program 1976, Sandy Hook Unit, Gateway National Recreation Area, Highlands, New Jersey. Sandy Hook Unit, Gateway National Recreation Area, National Park Service, Highlands, New Jersey.
Unknown	1977	B	O'Connell, Allan F. 1977. A survey and census study of tern, skimmer and heron colonies in Gateway National Recreation Area. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Floyd Bennett Field, Brooklyn, NY.
JBNWR	1978	U	Beatley, D.P. 1978. Ecological survey of the sea-gull population within the Jamaica Bay Wildlife Refuge: A preliminary report. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Jamaica Bay Unit, Brooklyn, NY. 15 pp.
JBNWR	?1978-1982	U	Burger, J. 1978-1982 Avian use patterns at Jamaica Bay Wildlife Refuge. Annual Report, Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, NJ. 23 pp.
Unk	1983	?B	Burger, Joanna. 1983. Black skimmer - least tern survey and restoration. Final report.
Sandy Hook	1994	?B	Nichols, Allison, Jenkins, C. David =, Jr. 1995. 1994 Least tern and black skimmer survey. State of New Jersey, Department of Environmental Protection, Division of Fish, Game and Wildlife, New Jersey.

Table 2-13. Waterbird Inventories at FIIS

Location in Park	Year(S)	Status	Bibliography
Throughout Park	1975-76		Osborn, R.G., Custer, T.W. 1978. Herons and their allies: Atlas of Atlantic Coast colonies, 1975-1976. U.S. Department of Interior, Fish and Wildlife Service, Office of Biological Services, FWS/OBS-77/08, Washington, DC.
Throughout Park	1977		Erwin, R.M., Korschgen, C.E. 1979. Coastal waterbird colonies: Maine to Virginia, 1977. An atlas showing colony locations and species composition. Publication No. FWS/OB5-79/08, U.S. Department of Interior, Fish and Wildlife Service, Biological Services Program, Washington, DC. 200 pp.
?Throughout Park	mid 1970's		Buckley, P.A., Buckley, F.G. 1980. Population and colony-site trends of Long Island waterbirds for five years in the mid 1970's. Transactions of the Linnean Society. Vol. 9: p. 23-54.
?Throughout Park	19??-Present	B	NY State Dept. of Environmental Conservation. 19??-Present Long Island Colonial Waterbird and Piping Plover Survey. Preliminary Tables, NY.
Throughout Park	1979		Stoutenburgh, Paul. 1979. Gulls of Fire Island. Fire Island Newsmagazine. Vol. 1 No. 2: 1 page.

Overview of Species-Habitat Relationships for GATE and FIIS

The bays and islands of the New York City area are extremely important for nesting and foraging by colonial waterbirds. They are most common where there is a prevalence of vegetated islands. The salt marsh, dredged material, and upland islands in the middle of Jamaica Bay are largely separated from disturbance and predation occurring on the surrounding mainland. Heronries also occur along the south shore bays of central and eastern Long Island including Great South Bay and Moriches Bay (bayside of FIIS). In areas with numerous islands such as the Jamaica Bay, the locations of heronries may shift significantly from year to year and from island to island, while there is higher site fidelity and long-term occupation in areas where there are only a few islands available for nesting.

The colonies of gulls and terns in the New York Bight are a significant component of the total Atlantic coast population. For example, in 1985 the New York Bight colonies of gulls and terns (excluding least tern (*Sterna antillarum*)) accounted for about 40% of the Atlantic coast population, dunes, beaches, and salt marsh islands and were widely distributed throughout the backbarrier lagoon system along the Atlantic shoreline of New Jersey and Long Island. Herring gull (*Larus argentatus*), for example, occurred at 146 different colonies in the Bight in 1995. During this same period, for the common tern (*Sterna hirundo*) alone, the 1985 population in the Bight accounted for over 73% of the total Atlantic coast population.

Populations of all three species of gulls, as well as two species of terns (common and roseate), have declined since 1989. There were about 79,000 pairs of gulls and terns recorded in the New York Bight in 1995, significantly fewer than in 1985 (118,000) or 1989 (132,000). The most significant decline has been in common tern, which has declined 72% since 1989. This regional decline is due in part to substantial declines at some of the larger colonies such as Cedar Beach (Jones Beach Island East) on Long Island, but declines have also occurred at smaller colonies throughout the region.

In its 1997 Significant Habitats and Habitat Complexes of the New York Bight Watershed report, the USFWS notes populations of long-legged waders have been fairly stable over the past two decades, although recent declines in snowy egret (50% decline since 1989) and cattle egret (*Bubulcus ibis*) (70% decline since 1989) are of concern. Double-crested cormorants (*Phalacrocorax auritus*) have recovered from earlier declines attributed to DDT and other pesticides and are expanding their range from the north, occupying habitat similar to that of herons and in some instances displacing them.

Species-Habitat Relationships at GATE

Breezy Point-Breezy Point supports one of the largest concentrations of least terns, with an average of 340 nesting pairs from 1985 to 1995 and a maximum of 703 pairs in 1992. This was the largest least tern colony in New York State for several years. More recently, the numbers have varied from 198 pairs in 1998 and 54 pairs in 1999. Breezy Point has consistently supported one of the largest black skimmer (*Rhynchops niger*) colonies in New York State; an average of about 194 pairs nested here from 1994 to 1999 with a maximum of 252 pairs in 1997.

Breezy Point has also supported the largest common tern colony on the south shore of Long Island since 1990, with an average of about 2,284 pairs from 1994 to 1999. Small numbers of roseate terns began nesting at Breezy Point in 1993. An average of 2.5 pairs were observed here between 1994 and 1999. The American oystercatcher was observed nesting at Breezy point in 1995 and 1998. Piping plover has been observed at Breezy Point each year since 1994 with one of the largest colonies recorded in New York. (The NPS monitors this species).

Jacob Riis Park-At Jacob Riis Park, common tern, great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), and American oystercatcher (*Haematopus palliatus*) are regular nesters. These bird species feed throughout Rockaway Inlet and Jamaica Bay.

Jamaica Bay and Islands-

Carnasie Pol-The heronry located on Canarsie Pol has supported a variety of nesting waders including glossy ibis (*Plegadis falcinellus*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), cattle egret (*Bubulcus ibis*), black-crowned night-heron (*Nycticorax nycticorax*), and tricolored heron (*Egretta tricolor*). In 2001, the following species were noted Black-crowned night heron, Great egret, snowy egret, tricolored heron, and glossy ibis. It was estimated that there were approximately 150 nests in 2001. Also, Canarsie Pol also has a history of nesting by the state-listed threatened common tern, as well as by great black-backed gull, herring gull, and American oystercatcher.

Ruffle Bar - No noted heronries have occurred on this island since approximately 1997. However, in 2001, four adult Black-crowned herons were observed flying from this island. It is noted that the presence of suitable nesting forest makes this island ideal for future colonization.

Common terns occur on several islands in Jamaica Bay, including Jo Co Marsh and Silver Hole Marsh, with smaller numbers at Duck Creek Marsh, East High Meadow, Ruffle Bar, and Subway Island. An average of about 1,000 common terns and a maximum of 1,630 common terns have nested on the combined seven colonies in Jamaica Bay since 1984.

Laughing gulls (*Larus atricilla*) re-colonized the bay in 1979. It increased from 15 to 7,629 nests between 1979 and 1990. Three nesting colonies are now located in the bay at East High Meadow, Silver Hole Marsh, and Jo Co Marsh. However, the colony declined by 64% to 2,720 nests in 2000 due to a program to reduce gull collisions with aircraft. These colonies, along with a small colony in West Hempstead Bay, represent the only colonies for this species in New York State and one of the northernmost colonies for this species.

Clapper rail (*Rallus longirostris*) and common moorhen (*Gallinula chloropus*) are also known to nest in the salt marshes in JBNWR.

Hoffman Island- In 2001, five species of long-legged waders were found nesting on this island with nearly active 400 nests located. Black-crowned heron were the most numerous of the wading birds, accounting for more than one-half (52%) of these nesters. Black-crowned heron nests were noted to be located for the first time on the north end of the island. These nests were found in privet. Nesting of herons, egret and ibis on this island in the past ten years has increased from fewer than a dozen nests in the early 1990's to about 400 nests in 2001. It is believed that only cattle egrets known to be nesting in the harbor occur here with only three nests noted. Also noted was the presence of a Little Blue heron adult that was possibly nesting and a tricolored heron observed flying into the island. `

Swinburne Island-In 2001, approximately 115 Double-crested cormorants were nesting on the trees and buildings of this island. It was noted that this colony has grown rapidly. Other species noted were Canada Geese (probable nesters); Herring (approximately 130) and Great Black-backed (80+) gulls nesting.

Sandy Hook - Sandy Hook is noted as a breeding ground for the American oystercatcher (*Haematopus palliatus*). Over 600 least terns nested along with the piping plover at the five Sandy Hook sites in 1995, the largest number of least terns in New Jersey that year. Common tern (*Sterna hirundo*) also nest at one site, and black skimmer have recently nested at another beach site on Sandy Hook.

Species Habitat Relationships at FIIS **Great South and Moriches Bay Islands**

In the past, common terns have nested in large numbers on four islands within FIIS boundaries but located in Moriches Bay. Two salt marsh/dredged material islands (Carter's Island and New Made Island) and two dredged material islands near Moriches Inlet (East and West Inlet Islands) (western end is located within FIIS boundaries), but only smaller numbers of terns have nested in recent years. These islands have also supported nesting by small numbers of black skimmer (*Rhynchops niger*) and American oystercatcher (*Haematopus palliatus*). West Inlet Island also had nesting by roseate terns in the 1980s. Carters Island supported the largest number of least terns on Long Island in 1995 (516 pairs). West Inlet Island has a heronry with great and snowy egrets (*Casmerodius albus* and *Egretta thula*) and glossy ibis (*Plegadis falcinellus*), as well as occasional nesting by double-crested cormorant (*Phalacrocorax auritus*) and herring and great black-backed gulls (*Larus argentatus* and *L. marinus*). Seaside and sharp-tailed sparrows (*Ammodramus maritimus* and *A. caudacutus*), clapper rail (*Rallus longirostris*), and green-backed heron (*Butorides striatus*) nest in adjacent salt marshes.

FIIS is one of the few Long Island locations where black rail have been sighted.

Experienced observers have verified Fire Island sightings of roseate terns foraging and staging in 1993 through 1995.

In addition, the William Floyd Estate has tidal areas where nesting American bittern (*Botarus lentiginosus*) have been documented (USFWS, 1997).

Monitoring Programs for GATE and FIIS

NYDEC Colonial Waterbird Survey

New York State DEC (NYDEC) has surveyed colonial waterbirds, terns and piping plovers on Long Island using ground counts annually since 1983. The 1998 NYDEC LI Colonial Waterbird and Piping Plover Survey recorded 21 species of nesting colonial waterbirds (Table: ?# GATE and FIIS Sites surveyed) and over 45,000 nesting pairs. Common terns, cormorants, herring, great black-backed and laughing gulls, and least terns are the most common nesting waterbirds listed (>2000 pairs per species). Great egret, black-crowned night heron, glossy ibis, and snowy egret are the most common species of long-legged waders nesting in the New York City area (>500 pairs per species).

Harbor Herons Project

The New York City Audubon Society has conducted the Harbor Herons Project regularly since 1984. Four islands managed by the NPS have been included in this survey since approximately 1991. These islands include Carnasie Pol and Ruffle Bar in Jamaica Bay and Swinburne and Hoffman Islands in the waters off Staten Island. As of 2002, other parts of Jamaica Bay will also be surveyed (pers. communication, Todd Fiorentino, NYC Audubon Society Executive Director). Don Reipe, NPS wildlife biologist, has participated and conducted these surveys on the NPS islands. The methods used do not vary from year to year. Teams of three researchers identify waterbird species present, nest abundance and locations, and nesting status. Summaries of this data are completed yearly. This data is also submitted to the NYDEC for inclusion in its' bi-annual Long Island Colonial Waterbird and Piping Plover Summary. Table ?? lists all sites, which are surveyed on NPS properties. Data from the most recent report has been obtained and will be entered into NPSpecies and the Metadata Catalog.

P.A. and F.G. Buckley Colonial Waterbird Studies

P.A. and F.G. Buckley, 1980, conducted a monitoring project regarding population and colony-site trends of Long Island for five years in the mid-1970s. This data will be entered into NPSpecies and the Metadata Catalog.

Rutgers University Colonial Waterbird Monitoring Program

A colonial waterbird monitoring program was conducted by Rutgers University between 1971 and 1990. All colonies in NJ and selected colonies on western LI (GATE-Sandy Hook Unit and Breezy Point) were ground surveyed.

J. Burger's Colonial Waterbird Studies

In addition, J. Burger at Rutgers University monitored Avian Use Patterns of shorebirds, waterbirds, Common Terns and waterfowl between 1978 and 1983. This work was published in the Jamaica Bay Studies I-VIII. This data is being requested and will be entered into NPSpecies when obtained.

Laughing Gull and Double-crested Cormorant Studies

Also important to note, are several Laughing Gull and Double-crested cormorant studies conducted between 1978 and 1986. Although these were studies and not long-term monitoring programs, population estimates were noted in many of the studies. Please refer to the NPS NRBib for GATE to locate these studies.

Suffolk County Piping plover/Least tern Protection Program

The Suffolk County Department of Parks, Recreation and Conservation manages a comprehensive Piping plover/Least tern Protection Program for thirteen parks throughout the county including Smith Point County Park which lies within FIIS boundaries. Least terns nest on the sandy beaches of the barrier beach complex to the west of Moriches Inlet at Fire Island East (Smith Point County Park). In 1995, 235 pairs of least tern on this stretch of beach were documented. In 2001, only nine pairs of least tern were reported by the Suffolk County Department of Parks at this site. An annual report is issued for this data and the data is given to

the NYDEC for inclusion in its annual report. This program and associated data will be entered into the Metadata Catalog.

SAHI

Species-Habitat Relationships

SAHI encompasses a 10-acre tidal saltmarsh on Eel Creek that colonial waterbirds may utilize. This saltmarsh is located near Oyster Bay Harbor where Oyster Bay NWR is located. A species list from this refuge notes the following species as breeding within the refuge: American Bittern, Green Heron, Black-crowned and Yellow-crowned Night Herons, and “solitary” breeding wader species Clapper Rails and Virginia Rail.

Monitoring Programs at SAHI

Breeding:

Aerial surveys, Population trends, BBA

In the 1970s, aerial surveys of the Long Island breeding waterbird colonies were conducted. Also, monitoring program regarding population and colony-site trends of Long Island was conducted for five years in the mid-1970s (P.A. and F.G. Buckley, 1980). Additional monitoring programs include the NY BBA (not exclusively SAHI data), Oyster Bay (historic data)/Northern Nassau County CBC (not exclusively SAHI data).

Currently, no long-term monitoring programs focusing on colonial waterbirds are being conducted at SAHI

Section V.3. Shorebirds

Introduction to Shorebirds found along the Atlantic Coast

Many species of shorebirds breed in interior regions of North America, especially in the Arctic and subarctic, and spend two-thirds to three-quarters of the year on migration routes and wintering grounds. Shorebirds show a strong affinity for wetlands, and typically swarm the beaches, marshes, and tidal flats during migration. Large numbers of migratory shorebirds travel great distances between breeding and wintering grounds and concentrate in small stopover areas with seasonally-abundant food resources to accumulate energy reserves for continuing their long-distance flights. Because large numbers of shorebirds are concentrated in just a few areas during migration, loss or degradation of key sites could devastate these populations.

Migrating species of shorebirds rely on a mosaic of shallow coastal or freshwater wetlands and adjacent upland areas and should be viewed as members of the Northeast and Mid-Atlantic coastal ecology. Foraging habitats include beaches, mudflats, sandflats, salt marshes, impoundments, flooded agricultural fields, and grasslands. Roosting habitats, usually used at night or during high tide periods when primary feeding areas are not accessible, include salt marshes, sandflats and beaches above the tide line, and sparsely vegetated islands free of predators. The Northeast Coastal Barrier Network includes at least four parks that play vital roles in providing foraging, roosting and resting habitats for over 30 species of migrating shorebirds throughout most of the year. These parks are ASIS, GATE, FIIS and CACO.

At low tide, birds fatten up on tiny invertebrates on the beach and in the mud flats; some double their weight in two weeks. At high tide, they rest on the open beach and preen their feathers into peak condition. All this is preparation for the next leg of their journey: a 2,000-mile non-stop flight toward their wintering grounds.

The greatest threats to migrating shorebirds are loss and degradation of coastal habitats and human disturbance. In particular, disturbance at roosting sites during high tide when migrating shorebirds are concentrated and particularly vulnerable; degraded water quality in the coastal bays and estuaries which affects the invertebrate food base upon which shorebirds depend; degradation of key migration stopover sites (loss of food base, loss of water quality and potential for direct physical harm to birds) by oil and chemical spills.

International Shorebird Survey (ISS) data have indicated recent declines in several species of shorebirds, including black-bellied plover (*Pluvialis squatarola*), whimbrel (*Numenius phaeopus*), red knot (*Calidris canutus*), sanderling (*Calidris alba*), semipalmated sandpiper (*Calidris pusilla*), least sandpiper (*Calidris minutilla*), and short-billed dowitcher (*Limnodromus griseus*). Counts at Delaware Bay have also documented regional declines in sanderling and semipalmated sandpiper.

Shorebird specialist, Brian Harrington, has studied 26 species that nest in North America; of these 18 have declined in the past two decades, one has increased, and the rest are level.

Semipalmated sandpipers have decreased by about half, and sanderlings (the tiny "wind-up" birds that run in and out with the waves) by about 80 percent.

Harrington has studied the impact of human-related disturbances on migrating shorebirds. Flight is costly to birds, he has found; every time a vehicle, a human on foot, or a dog rouses a flock of resting or feeding birds, the birds may pay a price. For some, it can significantly reduce the amount of fat they put on. Some birds Harrington has banded at low weights before migration are never seen by banders again, leading him to suspect that pre-migratory weight gain plays a key role in shorebird survival.

A limited number of shorebirds breed along the Northeast and Mid-Atlantic shoreline. Breeding shorebird species include the federally endangered Piping plover, Wilson's plover, American oystercatchers and willets.

The Piping Plover is endemic to North America, breeding on the upper Atlantic coast, in the Great Lakes region and on the great plains (Haig and Oring 195; Haig 1992) and wintering along the Atlantic and Gulf of Mexico coasts from North Carolina south and west to Florida, Texas and Mexico, as well as in the Bahamas and West Indies (Haig and Oring 1985; USFWS 1985). They breed along the Atlantic Coast from March through August (Dyer et al. 1988). Nesting locations are on sandy beaches and spits above the high tide line, on gently sloping dunes, in blowout areas behind dunes, in washover areas between dunes and on sandy dredge material (Dyer et al. 1988).

Human pressures such as coastal development, recreational activities, and disturbance by off-road vehicles have reduced the available suitable breeding habitat for these birds. No population increases were recorded from the 1970's to the 1980's. The Atlantic Coast Population of Piping Plovers is estimated to be about 1,372 breeding pairs. This group is considered to be a threatened species, and the Great Lakes population is listed as endangered.

Within the C&B Network, Piping plovers breed at CACO, FIIS, GATE and ASIS. The Endangered Species Act requires that all Federal agencies conserve and protect listed species within their jurisdiction. The Atlantic Coast Piping Plover Plan (FWS 1995) provides specific information on the species and recommends management actions. Each C&B Park with breeding Piping plovers must have its own Piping Plover Management Plan.

The Wilson's Plover currently breeds in coastal areas of the Americas from Virginia to Brazil, from Baja California to Peru, and within the West Indies (Johnsgard 1981). Nesting Wilson's Plovers were reported on the Chincoteague NWR end of ASIS (Watts, 1996). No known nesting pairs of Wilson's plovers have been reported within the NPS managed ASIS although a thorough search by a species expert on ASIS may be warranted.

Threats to tern and plover populations include loss of habitat, human disturbance, domestic animals and predators. Due to commercial, residential, and recreational development, the amount of coastal habitat available for nesting and feeding has decreased. Both eggs and the young birds are very well camouflaged, putting them in danger of being stepped on or otherwise disturbed by humans. Off-road vehicles pose a serious threat. Consistent use can degrade and destroy habitat. Even innocent sunbathing can have its effects on the birds; if the beach is crowded with people, feeding is interrupted and young birds may not get the nourishment they

need to survive. Dogs roaming unleashed on the beach disturb the birds and cats prey on chicks and adults at night. Other predators such as foxes, gulls, crows, raccoons, and skunks feed on eggs and young plover and tern chicks. They are often attracted to beaches by human picnic waste. At many Long Island sites, research has proven that predation is a major factor limiting nesting success at many Long Island sites.

Another shorebird species of concern is the American Woodcock. The long-term trends (1968-2001) of singing-ground surveys indicate an annual population decline of 2.5% in the Northeast. The decline is attributed to a decline in early successional stage hardwoods like aspen and alder. The decline in young forests is due to a number of factors including fewer farms being abandoned, increased urbanization and the decrease in management for early stage woodlands. To address the declining woodcock population, a Woodcock Task Force was established through the International association of Fish and Wildlife Agencies. The DEC Bureau of Wildlife is represented on the task Force. NYDEC continues to complete woodcock singing surveys in cooperation with USFWS. Currently, it is unknown if these counts are conducted in GATE, FIIS or SAHI.

ASIS

Table 2-14. Shorebird Inventories at ASIS Piping Plover

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Unk</i>	<i>1984-1996</i>	<i>B</i>	Author unknown. 1996. Results from ASIS monitoring program (1984-1996) to document the occurrence of shorebirds utilizing the ocean nearshore zone of Assateague Island, Maryland.
<i>Unk</i>	<i>1985</i>	<i>B</i>	Hoffman, Mark L. 1985. Status of the Piping Plover in Coastal Maryland.
<i>Unk</i>	<i>1991</i>	<i>B</i>	Horan, David J., MacIvor, Laurie H. 1992. Management, population dynamics, and breeding ecology of piping plovers on Assateague Island National Seashore, Maryland, 1991. Maryland Natural Heritage Program/National Park Service, Annapolis, MD.
<i>Unk</i>	<i>1990</i>	<i>B</i>	Loefering, John. 1990. ORV Zone Bird Survey.

Monitoring Programs at ASIS

Breeding:

Piping Plover Monitoring Program

Watts (1996) noted that in Virginia, both Piping Plovers and Wilson's Plovers nest, almost exclusively, on the Virginia Barrier Islands. In a ten-year summary of the annual plover survey of the Virginia Barrier Islands, he noted Assateague Island (Chincoteague NWR side only) as supporting 33% of all Piping Plover pairs. The average number of breeding pairs at Chincoteague NWR from 1986 through 1995 was 32.9 per year. The average number of

breeding pairs of Wilson's Plovers at Chincoteague NWR from 1986 through 1995 was 0.6 per year.

ASIS and Chincoteague NWR refuge staff monitor piping plover breeding over the entire breeding season. Monitoring of the Piping plover breeding success has been conducted on ASIS since the species was Federally listed as Threatened in 1986. Since 1985, all known Piping Plover nesting activity within the state of Maryland has been limited to ASIS. Primary management objectives for ASIS in 2001 included monitoring the breeding population, documenting productivity, limiting human disturbance and providing protection from predators. In addition, other beach-nesting bird species are monitored.

An estimated 60 pairs of breeding Piping Plover resided on the Maryland portion of ASIS during 2001. Nesting activity was documented on the northern 8.0 km of the island and in the off-road vehicle zone. Forty-one successful nests hatched 142 chicks, of which 55 survived to 25 days of age, for a productivity of 0.9 chicks fledged per breeding pair. It was noted that off-road vehicle use was limited or not permitted in the ORV zones in relation to bird use.

A total of 59 nests failed prior to hatching. Twenty-seven nests were lost to unknown causes, 24 were depredated and 8 were abandoned or unhatched. Based on tracks and disturbance at the nest, Fish Crow (*Corvus ossifragus*) and/or Boat-tailed Grackle (*Quiscalus major*), Red Fox (*Vulpes vulpes*), Raccoon (*Procyon lotor*) and gull (*Larus* sp.) were identified predators. Annual Monitoring and Management of the Piping Plover reports are published and include some data about other ground nesting bird species such as the Least tern (MD Threatened Species), American Oystercatchers, Killdeer, and Willets that breed on ASIS. All project data and GIS data are filed in the ASIS–NRM Electronic library with accompanying NRBIB and Dataset Catalog entries.

Migratory and Resident Shorebirds Monitoring Program

In addition to Piping Plover, ASIS resource management staff collected occurrence records documenting migratory and resident shorebirds as part of long-term monitoring program and between 1984 and 1996. In 1992, fifty-three species of shorebirds were observed using the beach or near-shore habitat. American Oystercatcher nests have been noted since 1993 at ASIS. The majority of the nests are located in the north end although a few nest are located in the ORZ zone.

CACO

Table 2-15. Shorebird Inventories of CACO

Species	Location in Park	Year(s)	Status	Bibliography
All Shorebirds	North and South Districts	1976-1990's	B	Cape Cod National Seashore Shorebird and Tern Reports-Various Authors, U.S. National Park Service

Table 2-16. Piping Plover Inventories of CACO

Location in Park	Year(s)	Status	Bibliography
North and South Districts	1976-1990's	B	Cape Cod National Seashore Shorebird and Tern Reports-Various Authors, U.S. National Park Service
Throughout Park	1986-Present	B	Various Authors. Piping Plover Monitoring Reports. Cape Cod National Seashore.
	1984-92	B	Melvin, Scott M. Status of Piping Plovers in Massachusetts - 1992 Summary.
	1989		Blodget, Bradford G. 1989. Piping Plover: 1989 Summary.
	1985-1987		MacIvor, Laurie H., Griffin, Curtice, =Dr., Melvin, Scott, =Dr. 1987. Management, Habitat Selection, and Population Dynamics of Piping Plovers on Outer Cape Cod, Massachusetts, 1985-87. National Park Service, Cape Cod National Seashore.
	1990		MacIvor, Laurie Hunt. 1990. Population Dynamics, Breeding Ecology and Management of Piping Plovers on Outer Cape Cod, Mass. University of Massachusetts, Amherst, MA.
	1992		Brown, Jennifer M. 1992. Breeding Ecology of Piping Plovers Nesting in Cape Cod National Seashore - 1992. Cape Cod National Seashore, CACO Natural Resource Report 92-02, South Wellfleet, MA 02663.
	1993		Brown, Jennifer M., Hoopes, Edwin M. 1993. Breeding Ecology of Piping Plovers in Cape Cod National Seashore - 1993. Cape Cod National Seashore, CACO Natural Resource Report 93-1, South Wellfleet, MA 02663.
	1997		Jones, L. Kyle. 1997. Piping Plover Habitat Selection, Home Range, and Reproductive Success at Cape Cod National Seashore, Massachusetts. M.S. Thesis. Department of Forestry and Wildlife Management, Graduate School of the University of Massachusetts Amherst.

Table 2-17. Tern Inventories of CACO

Location in Park	Year(s)	Status	Bibliography
North and South Districts	1976-1990's		Cape Cod National Seashore Shorebird and Tern Reports-Various Authors, U.S. National Park Service
	1983, 85		Blodget, Bradford G. Tern Inventory and Survey Data for 1983,1985.
	1934		Austin, O.L. =Jr. 1934. The status of Cape Cod terns in 1934: Contribution No. 18 from Austin Ornithological Research Station. Bird Banding. 5 4: 155-171.
	1944		Austin, Oliver L., =M.D. 1944. The Status of Tern Island and the Cape Cod Terns in 1943. Bird-Banding. A Journal of Ornithological Investigation. XV 4: 133.
	1946		Austin, Oliver L., =M.D. 1946. The Status of the Cape Cod Terns in 1944; A Behaviour Study. Bird-Banding. A Journal of Ornithological Investigation. XVII 1: 10.
	1935,36		Hagar, Joseph A. 1937. Least Tern Studies - 1935 and 1936. Massachusetts Audubon Bulletin. 5-8?
	Past-1973		Nisbet, I.C.T. 1973. Terns in Massachusetts: Present Numbers and Historical Changes. Bird-Banding. 44 1: 27-55.
	1990		Jones, Kyle. 1990. Roseate Tern Status.

Monitoring Programs at CACO

Breeding:

Piping Plover Monitoring Program

Migratory:

Protocol for Shorebird Monitoring

Currently, Michael Erwin and Robert Cook are developing a protocol for shorebird monitoring. The distribution, abundance and species composition of flocks of waterbirds including sandpipers and plovers is monitored over the course of the fall migration (July to November) at selected sites in the park. Sites are partitioned into smaller areas and all birds counted. Counts are conducted at low and high tide.

Wellfleet Audubon Society Shorebird Monitoring Program

In addition to this work, the Wellfleet Audubon Society monitors shorebirds at Wellfleet Harbor including Great Beach and Great Island.

Species Composition and Migration Chronology Study

An historical study of shorebirds at CACO includes Jennifer Brown's 1994 master's thesis on species composition, migration chronology.

COLO

Although COLO habitats include 37 miles of shoreline (34 acres), 2482 acres of wetlands, 3061 acres of floodplain, it does not support large numbers of shorebirds primarily due to its' predominance of emergent wetland. There are no accounts of breeding shorebirds at COLO. In addition, there are no documented records of COLO being a site that supports large numbers of migratory shorebirds. However, one species list for COLO notes 14 species of shorebirds in the park.

GEWA, THST, SAHI

There are no accounts of breeding shorebirds at GEWA, THST and SAHI. In addition, there are no documented records of any of these parks supporting large numbers of migratory shorebirds most likely due to their location and lack of appropriate habitat.

FIIS and GATE

Seven shorebird species nest within the New York Bight watershed, including beach-nesting shorebirds and grassland-nesting species. These seven species include Piping plover, Killdeer, American oystercatcher, Willet, Spotted sandpiper, Upland sandpiper, American woodcock. In contrast to the clumped distribution of gulls, terns, and long-legged waders, beach-nesting birds are more evenly dispersed along the ocean shorelines of Long Island and New Jersey.

Table 2-18. Shorebird Inventories of GATE

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Sandy Hook</i>	<i>1972</i>	<i>U</i>	Knorr, N.M. 1972. Report of shorebird banding at Sandy Hook, New Jersey, August and September 1972. Unpublished, U.S. Department of Interior, Fish and Wildlife Service, Bird Banding Station, Sandy Hook, NJ. 2 pp.
<i>Unknown</i>	<i>1978</i>	<i>U</i>	O'Connell, A.F. 1978. Shorebird estimates. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Floyd Bennett Field, Brooklyn, NY. 6 pp.
<i>Sandy Hook</i>	<i>1979, 80, 81,82,83,85</i>	<i>B</i>	Various Authors. Colonial nesting shorebird report. Sandy Hook, New Jersey. Gateway National Recreation Area, Natural Resource Management Office, Sandy Hook Unit, Highlands, NJ.
<i>Jamaica Bay</i>	<i>1983</i>	<i>U</i>	Burger, J., Gochfeld, M. 1983. Jamaica Bay Studies V: Flocking associations and behavior of shorebirds at an Atlantic coastal estuary. <i>Biology of Behavior</i> . 8 4: :289-318.
<i>JBNWR</i>	<i>1981-1986</i>	<i>M</i>	Various Authors, 1981-86. Fall shorebird season (1981-1986) at Jamaica Bay Wildlife Refuge. <i>The Kingbird</i> (spring).

Monitoring Programs at GATE and FIIS

NYDEC Breeding Colonies Monitoring Program

Survey groups from the New York State Department of Environmental Conservation, the Nature Conservancy, the Audubon Society and a network of concerned volunteers annually census the

breeding colonies on Long Island. With the cooperation of private and public landowners, fencing and signs prohibiting entry have been erected to protect existing colonies from disturbance. Tern/plover stewards actively patrol and monitor nesting sites to increase nesting success and alert the public to the vulnerability of these species to human disturbance.

The largest numbers of Piping Plover nest on sand barrier beaches and spits near inlets. The beaches of the New York area supported about a quarter of the total United States Atlantic coast population of piping plover in 1995.

There are 30 species of documented migratory shorebirds, plovers, sandpipers, avocets, and oystercatchers, that regularly use marine and freshwater habitats and adjacent uplands in the South Shore Reserve which is located along southern Long Island, New York for breeding, wintering, northward (spring) migration, or southward (autumn) migration (Table A-6).

Shorebirds migrate through New York almost all year round, with northward migration beginning in late winter and lasting through June, and southward migration beginning in late June with peaks in late July and lasting into the fall. Analyses of ISS data, Christmas bird counts, and migration season accounts from *American Birds* for the Western Hemisphere Shorebird Reserve Network (WHSRN) identified Jamaica Bay (autumn and spring migrations) as a site with counts of 5,000 or more shorebirds (Table A-7). There are also important shorebird concentration areas along the south shore of Long Island (i.e. FIIS) and other bays in New Jersey (i.e. Sandy Hook Bay) that appear to be under-represented in the ISS database and may have similar levels of shorebird use.

FIIS

Piping Plover

On Fire Island, adult Piping plovers forage on the ocean and bay beaches, in overwash areas, swale areas with sparse vegetation, and in vernal pool habitats. The primary habitat for breeding is along wide ocean beaches and overwash areas. Due to its rarity, available data identified only two to four nests per year in the late 1980's, with the numbers declining in the 1990's. Fire Island seems to be experiencing a rise in predators, and it is feared that the plovers' defense mechanisms may not be as effective when more predators are present.

The sandy beaches and dunes of the barrier island in the eastern reach of the Great South Bay support a few nesting sites for least tern and piping plover. Nesting success by piping plover in this long stretch of undisturbed beach may be limited by a lack of available feeding areas such as open vegetation, ephemeral pools, inlets, and access to bayside foraging areas, and possibly by predation. Human and off-road vehicle disturbance may also be a cause for low nesting success.

In recent years, plover breeding activity of territory establishment and courtship has increased on Fire Island; about ten pairs have nested, primarily along the beach in the Wilderness Area and south of Old Inlet. The extensive salt marshes fringing the barrier island on its northern edge and the associated mudflats provide resting and feeding habitat for thousands of migratory shorebirds, especially sandpipers, sanderling, plovers, and dowitcher during both spring and fall passages.

Carters Island supported the largest number of least terns on Long Island in 1995 (516 pairs). West Inlet Island's (western tip within FIIS boundaries) extensive tidal mudflats are a rich feeding ground for thousands of migratory shorebirds, especially in the fall; shorebirds using these mudflats include whimbrel (*Numenius phaeopus*), sanderling (*Calidris alba*), dowitcher (*Limnodromus* spp.), and several species of sandpipers and plovers, including piping plover. The flats also provide foraging habitat for sanderlings during the winter.

Piping plover and least tern nest on the sandy beaches of the barrier beach complex to the west of Moriches Inlet at Fire Island East (Smith Point County Park). This is one of the more important stretches of beach for these two species along Long Island's south shore. In 1995 there were 34 pairs of piping plovers on this stretch of beach.

Shorebird Monitoring Programs

NYDEC Colonial Waterbird Surveys

Both NY and NJ survey certain beach-nesting birds (piping plover and least tern) annually. The Long Island Colonial Waterbird and Piping Plover Survey is an annual survey since 1983. It is a cooperative effort of the NYDEC, The Nature Conservancy, U.S. Fish and Wildlife Service, Audubon chapters. NPS staff assist with gathering data at FIIS. Annual reports are produced and distributed by NYDEC. See Table 2 for most recent PIPL and tern data for FIIS.

Suffolk County Department of Parks, Recreation and Conservation Piping plover/Least tern Protection Program

The Suffolk County Department of Parks, Recreation and Conservation manages a comprehensive Piping plover/Least tern Protection Program for thirteen parks throughout the county including Smith Point County Park. The program was initiated in 1998. In 1998, four nesting Piping Plover pairs and three fledglings were reported; seven nesting pairs with three fledglings were reported in 2000 and six nesting pairs with nine fledglings were reported in 2001. It is noted that there is extensive erosion that has appeared to reduce suitable nesting areas and a significant predation problem caused by foxes at this site. It was recommended that that predator control and increased monitoring occur at this site. An annual report is issued for this data and the data is given to the NYDEC for inclusion in its annual report.

GATE

Species-Habitat Relationships

Sandy Hook- The sand spits extending into Lower New York Bay from Breezy Point and Sandy Hook have supported some of the highest nesting concentrations for piping plover in the NY Region. There has been a steady increase from eight nesting pairs of plovers in 1985 to 43 pairs in 1995 at Sandy Hook. Productivity of piping plovers at Sandy Hook is also consistently the highest in New Jersey, with an average of nearly 1.5 chicks fledged per nesting pair, compared with the statewide average of about 1.0 chick fledged per nesting pair. Willet breed on the sandy spit at the northern end of Spermaceti Cove and clapper rail nest in the salt marsh. American oystercatcher (*Haematopus palliatus*) nest on Skeleton Hill Island and feed throughout the

protected wetlands and shallow waters on the inside of the hook. Sandy Hook has also been noted as a breeding ground for the black rail.

Extensive use of the beaches by people at Sandy Hook has resulted in some disturbance of nesting birds and has created increasing public pressure for additional parking lots and open beach areas that would further diminish natural habitats in this area. Southern portions of the beach at Sandy Hook are threatened by erosion. In addition, sea level rise and dredging of channels and borrow pits have resulted in the loss of productive shallow water areas in the bays.

Jamaica Bay-Jamaica Bay is one of the most important migratory shorebird stopover sites in the New York Bight region, especially during fall migration (July to November). The shorebirds utilize much of the bay, but tend to focus on the intertidal areas during low tide and move to East and West Ponds on Ruler's Bar Hassock during higher tides. The water in East Pond is artificially lowered after July 1 each year. During the period 1981 to 1990 there was an average of 27 and a maximum of 36 shorebird species counted at the East and West Ponds in the Refuge during the fall. The most abundant shorebirds during that period were black-bellied plover, semipalmated plover, greater yellowlegs, ruddy turnstone, sanderling, semipalmated sandpiper, least sandpiper, dunlin, and short-billed dowitcher. Jamaica Bay is also important during spring migration (March to June) on the ponds for black-bellied plover, semipalmated plover, ruddy turnstone, red knot, semipalmated sandpiper, least sandpiper, and dunlin. Shorebirds known to breed in or around Jamaica Bay include killdeer, American oystercatcher, willet, spotted sandpiper, upland sandpiper, and American woodcock.

In addition, piping plover nested along the shoreline of John F. Kennedy Airport in 1984, but have not nested since. American oystercatcher nest at several islands in the bay for a total of 30 pairs in 1995; they also have nested along the airport shoreline.

Breezy Point- Breezy Point is the western tip of the Rockaway marine barrier beach with associated dunelands and residential development. Breezy Point consistently supports one of the largest piping plover nesting sites in New York, with an average of 22 pairs and a maximum of 33 pairs during the period 1985 to 1995. Also included in the Breezy Point unit are the portions of ocean beach extending east to Jacob Riis Park, presently used by beach-nesting birds. Other notable nesting shorebirds include willet, and American oystercatcher. Nesting and migrating piping plovers and other shorebirds feed on the intertidal beach.

Historical Shorebird Monitoring Programs at GATE

J. Burger at Rutgers University monitored avian Use Patterns of shorebirds, waterbirds, Common Terns and waterfowl between 1978 and 1983. This work was published in the Jamaica Bay Studies I-VIII. The fall shorebird migration was monitored at JBWR by NPS staff (Thomas Davis and Arthur Morris) from 1981 until 1988. Also, the NPS NRBIB lists a shorebird breeding success program conducted at Sandy Hook from 1985-1988 conducted by Jeanne Hickman-McArthur. In addition, Brian Harrington at Manomet Center for Conservation Sciences monitored shorebirds at GATE between 1970 and 1980 to determine species and abundance. No current shorebird migration monitoring at GATE is known to be occurring.

Section V. 4. Waterfowl

Introduction to Waterfowl found along the Atlantic Coast

Waterfowl are important components of wetlands and represent an enormous sport-hunting opportunity with an associated economic impact totaling tens of millions of dollars in the U.S each year. This popularity with the public has resulted in North American waterfowl being among the world's most thoroughly studied biota as efforts are made to refine their management.

In 1985, waterfowl populations had plummeted to record lows. Historical data indicated that since the first settlers arrived 53 percent of the original 221 million wetland acres found in the contiguous United States had been destroyed. The habitat that waterfowl depend on for survival was disappearing at a rate of 60 acres per hour. Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help in the recovery of a shared resource, the Canadian and United States governments developed a strategy to restore waterfowl populations through habitat protection, restoration, and enhancement. The strategy was documented in the North American Waterfowl Management Plan (NAWP) signed in 1986 by the Canadian Minister of the Environment and the United States' Secretary of the Interior. With its update in 1994, Mexico became a signatory to the Plan. (See Conservation Plan Section above for more detail regarding the NAWP)

The Atlantic Flyway route from the northwest is of great importance to migratory waterfowl and other birds some of which are flocks of Canvasbacks, Redheads and Lesser Scaups that winter on the waters and marshes south of Delaware Bay.

Several species of waterfowl use habitat within the C& B Network parks for migration, breeding and wintering. In its' **Significant Habitats of the NY Bight** report, the USFWS reports extensively on waterfowl use along the south shore of Long Island. Also in its' Technical Draft Report, the South Shore Estuary Reserve thoroughly documented the year-round use of habitats along Long Island and New York's south shores by waterfowl. These documents clearly state that habitats located along New York's south shores are critical to the survival of several species of waterfowl (See Sections below). The southern end of ASIS and its back bay are renown for its' abundance of wintering waterfowl. The Chesapeake Bay and its associated estuaries, inlets and tributaries including habitat most likely associated with COLO and GEWA are also known worldwide as premiere waterfowl wintering habitat. Due to their location along the east coast and the large size of many C&B network parks, waterfowl conservation and management should be recognized as a priority within these parks.

Waterfowl can be classified into four categories: dabbling ducks, diving ducks, geese and swans. All have webbed feet; short legs and most have wide, flattened bills. They migrate seasonally and depend on agricultural areas, bay bottoms and wetlands for food and nesting habitat. Each group has physical adaptations that are tailored to the birds' specific behavior and habitat requirements.

- Diving ducks, such as canvasbacks and redheads, have legs that are situated far back under their bodies, which permits them to dive deep in search of food but makes it awkward for them to walk on land.

- Dabblers, such as mallards and black ducks, have legs situated closer to the middle of their bodies, which enables them to walk easily but inhibits their diving ability. They feed in the shallows and can take flight without a running start.
- Canada geese are the most abundant waterfowl wintering in the Bay area. Other geese in this family include snow geese and brant. Each species has specialized bills for consuming agricultural plants, and submerged aquatic vegetation (SAV). With the decline of SAV in the Bay, Canada and snow geese now rely heavily on grain left in agricultural fields for food.
- The native tundra swan relies on the Bay only for its winter habitat. Along with the less numerous, introduced mute swan, it relies on SAV, and when SAV is scant, feeds instead on leftover grain.

Some Waterfowl Species with declining populations found on Atlantic Coast:

American black duck (*Anas rubripes*) are restricted geographically to eastern North America, with the highest breeding densities occurring in coastal marshes, especially those of the eastern shore of Chesapeake Bay. They raise their broods in SAV beds, emergent marshes, beaver ponds rich in SAV and insects and require that their brood rearing and nesting habitats be closely situated. Development can affect the areas where these habitats co-occur. This limitation, in addition to the ducks' intolerance to human disturbance, may contribute to their decline in population.

The majority of black duck wintering habitat is located from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina. The New York Bight watershed is at the center of both the breeding and wintering ranges for Black duck. About one-third of the total Atlantic flyway population winters in the New York Bight. Wintering black ducks are found, along with mallards, distributed in bays, marshes, and flats along the Hudson River, New York Harbor, and in the backbarrier lagoons of Long Island (FIIS) and New Jersey.

American black duck populations have declined dramatically over the past 40 years due to a combination of factors including habitat loss, over harvest, and competition and hybridization with mallards. The black duck was identified by the North American Waterfowl Management plan as a species of immediate international concern.

The wintering range of brant extends from Massachusetts south to South Carolina, but the majority (about 80%) of the wintering population occurs in the backbarrier lagoons of New Jersey and Long Island.

Greater scaup (*Aythya marila*) winter along the Atlantic coast between Cape Cod and Chesapeake Bay.

On the Atlantic coast, bufflehead winter from Newfoundland to Florida, with concentrations in Maine and between Cape Cod and North Carolina. Bufflehead feed on a variety of food items,

and in northern estuaries the primary winter foods are crustaceans such as isopods, amphipods, and shrimp, mollusks, some fish, pondweeds, and widgeon grass.

Canvasbacks are the largest of a group of widely distributed waterfowl known as pochards, or diving ducks. Canvasbacks forage in bottom sediments for subterranean plant and animal foods. Rootstalks, tubers and stems of submerged aquatic vegetation as well as bottom dwelling animals, such as aquatic insects and small crustaceans, are some of the canvasback's preferred foods. In Chesapeake Bay, the Baltic clam is a critical food source for wintering populations of canvasbacks.

The largest proportion of canvasbacks nest on the North American prairies, from Minnesota and the Dakotas through Manitoba, Saskatchewan and Alberta. Poor weather, pesticide poisoning, and predation by mink and raccoons can all have a detrimental impact on the eggs and ducklings. During migration and winter, canvasback flocks aggregate in Chesapeake Bay, San Francisco Bay, the Mississippi Delta region and adjacent Gulf coast, and interior Mexico.

Although the Bay is still important to canvasbacks, the decline of SAV wild celery (*Vallisneria spiralis*) has forced the ducks to winter on other coastal brackish waters where food is more abundant.

In the 1950s, the 250,000 canvasbacks that wintered on the Chesapeake represented one half of the entire North American winter population. Today, the Chesapeake harbors only about 50,000 canvasbacks-about one tenth of the estimated North American winter population. Canvasback numbers have substantially declined due to overharvesting, disturbance from shoreline development and recreational activities and habitat degradation (decline in SAV).

Diving ducks, such as redheads, are good indicators of water quality because they feed on bottom-dwelling plants and animals that depend on good water quality. The redhead, continues to feed almost exclusively on SAV, and has not been as successful in adapting its feeding habits to the loss of its food source. Redheads have experienced population declines that roughly correspond with losses of submerged aquatic vegetation. Chesapeake Bay redhead populations dropped to around 1,500 in the early 1990's, down from 38,000 redheads recorded in the late 1950's. Scientists hope that current increases in the bay's submerged aquatic vegetation will help support more redheads. The Chesapeake Bay Program set a goal of 8,200 redheads by the year 2000 (Chesapeake Bay Program 1990).

The Atlantic Flyway hosts two distinct populations of Canada goose, resident and migratory, during the winter. Resident, non-migrating geese use golf courses, urban parks, and other protected areas. This resident population has exploded to the point that the birds are a nuisance in many areas. However, migratory populations of Canada goose that nest on the Ungava Peninsula in northern Quebec have declined dramatically (about 75%) since 1988.

Midwinter waterfowl surveys in the Chesapeake Bay region showed a decline in Canada geese, from more than 555,000 individuals in 1985 to 298,000 individuals in 1995. That same year due to the continued poor production, the Atlantic Flyway Council recommended that the hunting season be closed in the U.S. and Canada. In 1995, the hunting season was closed on migrant Canada geese throughout the Atlantic Flyway.

Since then, Atlantic Population Canada geese have increased from a low of 29,000 breeding pairs in 1995 to 63,000 breeding pairs in 1997. In 1998, the number of breeding pairs declined by 33 % to 42,000. This decrease, however, may be partly due to an earlier than normal spring and nesting seasons. At the time of the survey many goslings had already hatched.

Most recently, New England-based research has confirmed historic accounts that a separate population of Canada geese breeds in maritime Canada and that these birds winter predominantly in southern New England and on Long Island, New York.

ASIS

Waterfowl Inventories of ASIS

- Harvey, Bill. 1989. Maryland Waterfowl Breeding Survey.

Monitoring Programs at ASIS

Midwinter Aerial Survey and Waterfowl Breeding Surveys

These surveys are conducted by MD DNR-It is currently unknown if waterfowl breeding surveys have been conducted at ASIS by MD DNR. It is currently unknown who the contact person is at MD DNR regarding this waterfowl data. Once this data is obtained, it will be entered into NPSpecies and the Meta Data Catalog.

National Wildlife Refuge (NWR) Data

All waterbirds, including waterfowl, are counted at the refuges every two weeks and at the management area monthly. The counts show the importance of salt marsh habitats to waterfowl year round and the seasonal occurrence of waterfowl species at each refuge. Several of the Coastal Network sites have refuges within their boundaries or adjacent/nearby their boundaries ASIS including Chincoteague NWR

Kirkpatrick's Waterfowl Population Assessment

A Waterfowl Population Assessment at Assateague Island National Seashore was conducted by Roy Kirkpatrick et al (Virginia Polytechnic and State University) in 1992. Kirkpatrick's assessment was a compilation of historic data from available sources providing population trend data from 1979 to 1991 in addition to providing a summary of taxonomy, natural history, and population status of waterfowl species of ASIS. He also conducted monthly aerial surveys to provide temporal and spatial data on waterfowl species at ASIS during winter 1991-92 and provided recommendations for monitoring protocols of waterfowl on ASIS.

Currently, there are no known monitoring programs occurring for waterfowl at ASIS aside from the Midwinter Aerial survey.

COLO

Species-Habitat Relationships

The Chesapeake Bay has always been a favored winter residence or stopover for many species of waterfowl on their way south from their summer breeding grounds. The shallow waters and wetlands of the Bay and its temperate climate offer a fertile and diverse environment for waterfowl.

For some birds, the Chesapeake Bay is their winter destination. More than a million waterfowl migrate through or overwinter in Chesapeake Bay (Midwinter Waterfowl Survey, U.S. Fish and Wildlife Service, Arlington, Virginia, and Seaduck Survey, Chesapeake Bay Field Office, Annapolis, Maryland, unpublished data). This is roughly one third of all waterfowl wintering along the Atlantic Coast.

It is estimated that at one time, millions of waterfowl spent their winters in the Bay region, supported by profuse SAV beds and supplemental diets rich in invertebrates. The destruction of wetlands and dramatic declines in SAV, and water quality, human interaction, overhunting, and poaching have reduced the number of waterfowl in the Chesapeake Bay area to about one million birds.

Monitoring Programs at COLO

The Chesapeake Bay Coastal Program is working with other federal, state and local agencies to protect living resources. Under a Memorandum of Agreement with the Environmental Protection Agency, the U.S. Fish and Wildlife Service is a major partner in the Chesapeake Bay Program, a multi-agency effort to restore living resources and water quality of the Chesapeake Bay. Through its participation, the Service has facilitated a number of important activities such as: Completed a comprehensive survey of all Chesapeake Bay waterbirds; Conducted a 40-year waterfowl status and trends study; Coordinated Chesapeake Bay wetlands status and trends survey; Coordinated development of a Chesapeake Bay habitat restoration strategy and restored thousands of acres of wetlands and other important fish and wildlife habitats throughout the Chesapeake Bay watershed. Data from the waterbird survey and waterfowl status and trends study has been requested.

CACO

Monitoring Programs at CACO

In addition to the BBA, BBS, CBC, the Wellfleet Audubon Society is located near to CACO and maintains a year-round bird species list.

Massachusetts Division of Wildlife (MassWildlife):

Mid-winter Waterfowl Survey: It takes 3 to 4 days to fly Massachusetts' 2,200 miles of coastline, which includes CACO. Normally two planes are used to take maximum advantage of the brief periods of good weather in early January. Results are usually tabulated by the middle of

the month for Massachusetts, but figures for the entire flyway are not available until late February. For more information call H. Heusmann (508) 792-7270.

MassWildlife cooperates in other joint surveys with the US Fish and Wildlife Service and with biologists from other state fish and wildlife agencies. As part of the cooperative interstate effort to manage waterfowl, the Division heads up the northeastern waterfowl breeding survey, engages in summer banding efforts, and participates in the Atlantic Flyway Council meetings. At this time, it is unknown if any of this work is being performed at CACO.

National Wildlife Refuge Data:

All waterbirds, including waterfowl, are counted at the refuges every two weeks and at the management area monthly. The counts show the importance of salt marsh habitats to waterfowl year round and the seasonal occurrence of waterfowl species at each refuge. Monomoy NWR is located adjacent to the southern end of CACO.

In addition to these monitoring programs, a study regarding Black Duck ecology was completed in 1972.

Grandy, John W. =IV. 1972. Winter Ecology of Maritime Black Ducks (*Anas rubripes*) in Massachusetts, with Special Reference to Nauset Marsh, Orleans and Eastham. Ph.D. Dissertation. University of Massachusetts, Amherst, MA.

GATE

Table 2-19. Waterfowl Inventories at GATE

Location in Park	Year(s)	Status	Bibliography
Jamaica Bay	1968	U	Meacham, C.H. 1968. Jamaica Bay waterfowl use survey 1967-1968. U.S. Department of Interior, Fish and Wildlife Service, Boston, MA. 7 pp
Sandy Hook	1974	U	New Jersey Department of Environmental Protection, Division of Fish Game, and Shellfisheries, Bureau of Wildlife Management. 1974. Waterfowl population and distribution survey. New Jersey Department of Environmental Protection, Division of Fish, Game, and Shellfisheries, Bureau of Wildlife Management, Trenton, NJ. 5 pp.
Jamaica Bay	1984	U	Burger, J., Trout, J.R., Wander, W., Ritter, G.S. 1984. Jamaica Bay Studies VII: Factors affecting the distribution and abundance of ducks in a New York estuary. <i>Estuarine, Coastal, and Shelf Science</i> . 19 6: :673-689.
JBNWR	1987	W	Riepe, Don. 1987. Winter waterfowl census. U.S. Department of the Interior, National Park Service, Gateway National Recreation Area, Jamaica Bay Wildlife Refuge, Brooklyn, NY 11234.

Species-Habitat Relationships

The New York Bight accounts for about one-quarter of the Atlantic flyway wintering population. Within this park, the most important wintering area is the Raritan Bay-Sandy Hook Bay area. The adjacent waters of Long Island Sound are also an important wintering waterfowl area. Greater scaup feed primarily on benthic invertebrates such as clams, mussels, and snails. These food preferences may make scaup more susceptible to bioaccumulation of contaminants in polluted areas. Analyses of scaup kidneys and livers from Long Island Sound have revealed that tissue levels of chlorinated hydrocarbons and heavy metals increased during the winter, and

levels of cadmium, selenium, and PCBs were at levels known to adversely affect reproduction in ducks. Midwinter inventory data show significant long-term declines in scaup, and the declines in greater scaup may be even more pronounced.

Jamaica Bay has significant wintering waterfowl concentrations, with mid-winter ground counts over the period from 1980 to 1992 averaging about 11,000 birds, with a peak of 36,000 birds. The most abundant waterfowl during this survey period were greater scaup, American black duck (*Anas rubripes*), brant (*Branta bernicula*), Canada goose (*Branta canadensis*), bufflehead (*Bucephala albeola*), canvasback (*Aythya valisneria*), mallard (*Anas platyrhynchos*), ruddy duck (*Oxyura jamaicensis*), red-breasted merganser (*Mergus serrator*), snow goose (*Chen caerulescens*), and American wigeon (*Anas americana*). Jamaica Bay supports some of the largest wintering populations of greater scaup and American black duck in New York State. Regularly occurring waterfowl in lesser numbers include horned grebe (*Podiceps auritus*), green-winged teal (*Anas crecca*), gadwall (*Anas strepera*), northern shoveler (*Anas clypeata*), and common goldeneye (*Bucephala clangula*). Concentrations of waterfowl also occur in the bay during spring and fall migrations. A year-round weekly survey of birds in Jamaica Bay during 1978-1979 counted a total of 263,607 ducks of 32 species. The most abundant ducks on a year-round basis that year were greater scaup, American black duck, canvasback, and mallard. Waterfowl confirmed breeding in the bay include Canada goose, American black duck, mallard, northern shoveler, gadwall, redhead (*Aythya americana* - introduced), and ruddy duck. Waterfowl hunting in Jamaica Bay is prohibited.

FIIS

Prior Waterfowl Inventories of FIIS

- No Author. 1984, 1985, 1986, 1991, 1993. Waterfowl Count.

Species-Habitat Relationships

The productive bay waters of the Fire Island National Seashore Wilderness Area are known for high concentrations of wintering waterfowl, especially scaup, pied-billed grebe (*Podilymbus podiceps*), American black duck, and red-breasted merganser, which gather to feed and rest there. Important wintering sites appear to be the salt marsh-dominated bays such as Great Bay on Long Island.

The South Shore Estuary Reserve (SSER) Waterfowl Draft Technical Report notes that for 1970-1996, the average total waterfowl count for all segments within the SSER was more than 42 thousand birds and the maximum more than 82 thousand birds. Four species accounted for more than 86 percent of total species: scaup (greater and lesser scaup not differentiated), brant, American black duck and Canada geese. Great South Bay had the highest average total counts primarily due to high numbers of scaup (6,563 average). On a per area basis, Fire Island had the second largest number of birds counted per acre.

Fourteen waterfowl species are known to nest and breed in the south shore estuary where FIIS is located. A breeding data summary from the 1980-1985 New York State Breeding Bird Atlas notes Mallard, Canada goose, American Black Duck and gadwall are the most prevalent on Fire

Island. Several species such as green winged teal and American wigeon are at the southern end of their breeding range and are sparse and occasional breeders in this area.

The Captree and Central Suffolk Christmas Bird Counts (CBC's) are conducted partially within FIIS lands. These counts and two other counts (southern Nassau County and Quogue-Watermill) in the South Shore Estuary Reserve were initiated in 1966. A summary of these four counts from the SSER Waterfowl Draft Technical Report notes that when averaged over five-year intervals, long-term trends in waterfowl numbers become evident. The total waterfowl count increased slightly in the early 1980's, due in part to high counts of greater scaup, and has shown slight declines since then. Peak total count in 1983 was 115,163 waterfowl. Increase from the 1960's to the 1970's may be partly due to increased CBC observer effort, although waterfowl counts are often less sensitive to observer effort bias than counts made for terrestrial species (Bock and Root 1981). As many as 36 waterfowl species have been recorded annually on the four south shore CBC's. The most abundant species recorded, accounting for more than 80 percent of the total waterfowl counted were, in order of decreasing abundance, brant, greater scaup, American black duck, Canada goose and mallard. Least common winter species, tundra swan, snow goose, wood duck, blue winged teal and harlequin duck are not observed every year. Of the four most abundant species, counts of brant and Canada geese have increased from 1966 to 1995. Black duck counts have remained stable and counts of greater scaup showed peaks in the 1970's and 1980's but in recent years have declined.

FIIS and GATE Waterfowl Monitoring Programs

In addition to the BBA and CBC, which may have included other areas outside of park boundaries, the following monitoring programs for waterfowl have been conducted at either FIIS, GATE or both parks:

USFWS Waterfowl Surveys of the 1960's

Extensive ground and aerial waterfowl surveys were conducted in the Great South Bay and Moriches Bay (including FIIS) in the 1960's for the U.S. Army Corps of Engineers as part of the Fire Island Cooperative Beach Erosion Control and Hurricane Protection Project (USFWS 1965, 1969a, and 1969b). Once the data from this work is obtained, it will be entered into NPSpecies.

Mid-Winter Aerial Survey Data

Along the south shore of Long Island, New York's DEC makes these surveys from fixed wing aircraft. Contact with Bryan Swift, NYDEC waterfowl biologist, revealed that NYS waterfowl data specifically SAHI, FIIS and GATE was unavailable. However, a summary of this data in the South Shore Estuary Technical Draft Report (2000) noted the following trends: Total waterfowl counts within SSER have declined from the early 1970's to the early 1990's, with an annual average of 63, 278 birds 1970-1975 and an annual average of 39, 558 birds 1990-1995 which is a 37 percent decline. It is noted that this change is due to the drop in scaup numbers from an annual average of 28, 974 birds 1970-1975, to an average of 6,911 birds 1990 to 1995, which is a 76 percent decline for this species. Numbers of black duck also declined over this period, from 10, 403 birds in 1970-1975 to 7, 242 birds in 1990 to 1995, which is a 30 percent decline. Brant and Canada goose show stable or slightly increasing trends over the same

period. In relative numbers, the percentage of total waterfowl in the SSER area consisting of diving ducks decreased from 50 to 22 percent, while geese (including brant) increased 27 to 56 percent. Dabbling ducks remained constant at 21 percent.

It was noted that total numbers and short-term trends from aerial survey data are generally not directly comparable to CBC data for a variety of reasons. Despite these differences, CBC's and the Midwinter Aerial Survey data both show an overall decline in scaup. Based on ground observations, most of the scaup counted are greater scaup and this species is a large percentage of state and flyways totals.

New York Federated Bird Clubs Winter Waterfowl Counts

The Federation of New York State Bird Clubs has conducted annual waterfowl ground surveys from 1955 (1968-1972 no data)-present. Ground counts are conducted in January and the results are reported in the journal *Kingbird*. These counts are useful for determining statewide or regional status or trends. These counts are reported only on a large regional basis, e.g., total number of a species counted in the Long Island/New York City Region and survey areas may change from year to year; therefore, they are not usually useful for determining waterfowl status and trends in particular parks or adjacent areas. However, Don Reipe, NPS biologist stationed at JBNWR, has gathered data for wintering waterfowl specifically in Jamaica Bay over the last several years for NYFBC. This data has been entered into NPSpecies (Davis, 1996).

National Wildlife Refuge Data

GATE includes Jamaica Bay NWR (also see above section). The Wm Floyd Estate, which is part of FIIS, is located near (approximately 2 miles) the Wertheim NWR.

Comprehensive Monitoring Study at Wm. Floyd Estate

Currently, a cooperative effort with USGS/USFWS/Moriches Bay Audubon Society at the Wm. Floyd Estate is underway to conduct annual surveys that include water tables, salinity levels, vegetation characteristics, invertebrate surveys including mosquitoes, waterfowl surveys and fish surveys. Data collection began in the fall of 1999. A brief summary of species data was completed by Ernest Taylor and will be entered into NPSpecies.

Waterfowl Counts at Wm. Floyd Estate

Listed in NRBIB, waterfowl counts were conducted from 1982-1994 at the Wm. Floyd Estate. This data will be requested and entered into NPSpecies once obtained.

Avian Use Patterns of shorebirds, waterbirds, Common Terns and waterfowl in Jamaica Bay at GATE

J. Burger at Rutgers University conducted this work between 1978 and 1983. This work was published in the Jamaica Bay Studies I-VIII.

SAHI

Species-Habitat Relationships

SAHI encompasses a 10-acre tidal saltmarsh on Eel Creek that waterfowl may utilize. This saltmarsh is located adjacent to Oyster Bay Harbor where Oyster Bay NWR (OBNWR) is located. Regular waterfowl surveys throughout the year are conducted at OBNWR. Thirty species of waterfowl have been documented at the refuge. Nine species that breed at OBNWR include Mute Swan, Canada Goose, Wood Duck, Green winged Teal, American Black Duck, Mallard, Blue-winged teal, Gadwall, American Widgeon, and Red-breasted merganser. Species data will be entered into NPSpecies as “probables” for SAHI.

Monitoring Programs at or near SAHI

Aside from the CBC and BBA that also included other areas outside of SAHI, no waterfowl inventories or monitoring programs have ever been conducted at SAHI. However, Theodore Roosevelt Sanctuary (TRS) is located adjacent to SAHI and it conducts annual Winter Waterfowl Surveys. Data from that program has been requested. Once the data is obtained, species data will be entered into NPSpecies as “probables” for SAHI.

THST

Monitoring Programs at or near THST

CBC

Recent and historical CBC species lists from Port Tobacco, Maryland, where THST is located, list several species of waterfowl including Tundra swan, Canada goose, American Black duck, Canvasback, Gadwall and Lesser scaup. These species were most likely identified on the Port Tobacco River since it is the largest water body associated with Port Tobacco.

The majority of THST lands fall within the Hog Hole Run sub-basin, which is a tributary of the Port Tobacco River. Hog Hole Run, a perennial stream, lies adjacent to the western boundary of Thomas Stone NHS. It is possible that some of the waterfowl species listed above may be found at THST.

Waterfowl Breeding Surveys

These surveys are conducted by MD DNR-It is currently unknown if waterfowl breeding surveys have been conducted at THST by MD DNR. It is currently unknown who the contact person is at MD DNR regarding this waterfowl data. If this data is available for THST and once this data is obtained, it will be entered into NPSpecies and the Meta Data Catalog.

Section V.5. Raptors

Introduction to Raptors found along the Atlantic Coast

Habitats found within the C&B network including dunes, swales, salt marshes and large forested tracts of land are most likely important hunting grounds for migrating and wintering hawks and owls, including the Bald Eagle (*Haliaeetus leucocephalus*), peregrine falcon, American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), Cooper's hawk, sharp-shinned hawk (*Accipiter striatus*), northern harrier, osprey, short-eared owl, saw-whet owl and snowy owl (*Nyctea scandiaca*). Bald eagles, peregrine falcon, Northern Harrier, Coopers and sharp-shinned hawk, red-tailed hawk and various owls and American kestrel also use these habitats for breeding.

Three of the C&B parks (FIIS, GATE and CACO) have hawk watches conducted on their lands. However, there is a paucity of information regarding breeding raptor species and wintering species on the C&B network lands excluding information that may be obtained from the CBC and BBA data. In particular, there is very little information about breeding Northern Harriers that rely on grasslands for feeding and very little information regarding its status on C&B park lands. (Double check) PIF lists this species as a species of high priority for conservation. Also, very little information has been found about breeding owls within the C&B network.

Raptors can be good indicators of health of an ecosystem. Currently, NJ Endangered Nongame Species Program (ENSP) biologists are investigating the possible impacts of organochlorines and heavy metals in eagles and other raptors nesting in the Delaware Bay region. Bald eagles, ospreys, and peregrine falcons nesting in the region exhibit some reproductive impairment relative to other areas (Steidl, 1991 and ENSP unpub. data). The ENSP monitors these species during the nesting season to evaluate nest success and assess any problems that occur.

The osprey's high visibility and position at the top of the aquatic food chain make it a valuable indicator species for detecting future habitat destruction, dwindling fish populations, and contamination of the environment. Although ospreys are now a common sight on Chesapeake Bay, two to three decades ago they faced possible extinction along much of the Atlantic coast. For years, they were unable to produce enough young to maintain the population. Production was down because of egg failures caused by extremely thin and easily broken eggshells. Years of research led to the discovery that their eggshell thinning was caused by the pesticide DDT, which had been in heavy use since World War II for spraying mosquitoes and crop pests. DDT was banned from use in the U.S. in the early 1970s and the osprey and some other affected birds of prey have made remarkable recoveries. The help of people in constructing thousands of artificial nest platforms has also benefited the osprey. However, intensive human development along shorelines still can harm the aquatic environment that ospreys depend upon. Some areas of the Bay are low in fish abundance and cannot support highly productive osprey colonies. In these areas, perhaps one young will survive for every nest whereas other areas with more fish can produce two or three fledglings per nest.

Due to lack of species data for most raptors in the C&B parks, species lists from CBC's and BBS's will be discussed when available for each park.

ASIS

Table 2-20. Raptor Inventories at ASIS

Location in Park	Year(s)	Status	Bibliography
<i>Unk</i>	1990	B	Brinker, David F. 1990. Maryland Osprey Survey.
<i>Chincoteague</i>	1971	B	Virginia Department of Game and Inland Fisheries. 1971. Virginia Osprey Study.
<i>Unk</i>	1991	M	Brinker, David F. 1991. Use of Assateague Island National Seashore by Northern Saw-Whet Owls During Migration and Winter.
<i>Chincoteague</i>	1990	Unk	Byrd, Mitchell A. 1990. Status of the peregrine falcon (<i>Falco peregrinus</i>) on the Virginia barrier islands. Pages 389-403 in Martin, James H. Biota of the Virginia Barrier Islands. Virginia Academy of Science, Richmond, VA.
<i>Unk</i>	1971	M	Berry, R.B. 1971. Peregrine falcon survey, Assateague Island, Maryland, fall 1969. Pages 31-43 in No Author. Raptor Research News.

Monitoring Programs at or near ASIS

Peregrine falcon monitoring

In 1970, the Department of the Army initiated a program to monitor the tundra peregrine on ASIS and to develop new techniques to assist in the study of highly migratory threatened, endangered and sensitive species. This monitoring program now also includes the American peregrine falcon and has continued on the entire island including Chincoteague NWR for the past 32 autumn migrations.

Midwinter Bald Eagle Survey

The Midwinter survey on ASIS has consistently found non-breeding Bald eagles. In 2001, the first breeding pair of Bald eagles was found on ASIS. Two breeding pair are also known to nest in the Virginia portion of Assateague Island.

Northern Saw-whet owl monitoring

David Brinker who has conducted this long-term monitoring program since 1990 on ASIS focuses on trapping and banding the Northern Saw-whet to document migration movements of saw-whet owls in the northeastern United States. Banding data is compared to other Maryland locations to establish geographic differences in phenology and geographic patterns in age/sex class structure. Other efforts will improve the understanding of how saw-whet owls utilize barrier island habitats during the winter by assessing winter distribution and density. During the autumn of 1999, migration monitoring was conducted on Assateague Island nightly from 15 October through 8 December and 285 Northern Saw-whet Owls were mist netted. Six owls banded elsewhere were recaptured. These owls were originally banded in Ontario, Maine, Pennsylvania, and New Jersey. Two of the owls banded on Assateague during the autumn of 1999 were subsequently retrapped at other owl monitoring stations. In the 9 autumns since this study was initiated the only year when more owls were banded was 1995 when 332 owls were netted. Data from the autumns of 1995 and 1999 are very similar. Immature owls comprised 85% of the total owls netted during 1999. A significant proportion (25-35%) of autumn banded owls remain to winter on Assateague Island. Winter studies in 1999 netted 10 owls, 90% of which had been banded during autumn 1998 migration monitoring. Winter 2000 studies are ongoing.

BBS

Recent BBS data (1992-2001) from Chincoteague NWR on Assateague Island lists Osprey, Northern Harrier (1996 only), Red-shouldered Hawk (1993 only) and Red-tailed Hawk, Eastern screech-owl (1999 only), Great Horned Owl and Barred Owl as present. No other known raptor monitoring programs are presently occurring at ASIS

CACO

Raptor Inventories at CACO

In a mid-1990's, a survey of grassland/heathland birds was conducted at CACO. A repeat of this survey was conducted in 2000. While not quantified, the Massachusetts Threatened Northern Harrier (*Circus cyaneus*) was frequently observed and nesting confirmed.

Monitoring Programs at or near CACO

Pilgrim Heights Hawk Watch

The Massachusetts Audubon Society's Wellfleet Bay Wildlife Sanctuary, in partnership with Eastern Massachusetts Hawk Watch, conducts an annual spring hawk watch on Pilgrim Heights at CACO. The data will be used monitor hawk species and their abundance. This project began in 1998 although counts have occurred at Pilgrim Heights and at other locations on the Outer Cape in the past. Species data has been obtained and will be entered into NPSpecies as "probables" for CACO.

BBS data

Data from the BBS 1989-1999 at CACO list Northern Harrier (1990 only); Red-tailed Hawk (1996 only) and the American kestrel (1995 only) as present.

COLO

Table 2-21. Bald Eagle Inventories at COLO

<i>Location in Park</i>	<i>Year(s)</i>	<i>Status</i>	<i>Bibliography</i>
<i>Throughout Park</i>	<i>?- Present</i>		Author unknown? (no author included in original record). 1998. Bald Eagle/Heron Survey Report for Colonial National Historical Park. Center for Conservation Biology, College of William and Mary, Williamsburg, VA.
	<i>1997</i>		FWIS. 1997. Eagle Nest Locations in James City and Surry Counties. 8x10.
	<i>1989</i>		Rafkind, Chuck. 1989. Eagle nesting, et al. National Park Service, Yorktown, VA.

Monitoring Programs at or near COLO

Bald Eagle Aerial Surveys

Currently, Bald Eagle nests at COLO are monitored using aerial surveys in March and then one more time in the nesting season to determine survivorship of the nestlings. Mitchell Byrd and Bryan Watts at the College of William and Mary's Center are completing this work for Conservation Biology.

BBS data

Recent data from the COLO Parkway BBS lists Osprey, Red-shouldered Hawk and Red-tailed Hawks as present. No other known raptor monitoring programs is presently occurring at COLO.

FIIS

Species-Habitat Relationships

There is limited data on breeding and wintering raptor species at FIIS; however, the beach in the Wilderness Area and south of Old Inlet is important for wintering northern harrier, which are possible breeders, short-eared owl, and snowy owl (*Nyctea scandiaca*), all of which forage over swales and the extensive salt marshes fringing the barrier island on its northern edge. Also, data from the BBS 1966-1996 at Jones Beach on FIIS list Osprey (1990 only) and the eastern screech-owl (1996 only) as present. The American kestrel was noted as present in 1966 and 1969.

Monitoring Programs at or near FIIS

FIIS Lighthouse Hawk Watch

A hawk watch and count at the lighthouse on Fire Island averages over 9,000 raptors during the autumn migration. The most abundant raptors counted, in declining order of abundance, are American kestrel (*Falco sparverius*), merlin, sharp-shinned hawk (*Accipiter striatus*), northern harrier, osprey, peregrine falcon, and Cooper's hawk (*Accipiter cooperii*). This data has been obtained and will be entered into NPSpecies.

FIIS Lighthouse Hawk Banding Station

Also, a hawk banding station located near FIIS lighthouse administered by Theodore Roosevelt Sanctuary has been conducted in the recent past. Contact with the research director revealed that this trapping station was not productive. However, the TRS data will be entered into the NPSpecies database once it is obtained.

GATE

Table 2-22. Raptor Inventories at GATE

Location in Park	Year(s)	Status	Bibliography
Throughout Park	1974,75		Griffin, J. 1974-1975. Osprey and nest bird survey. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Brooklyn, NY. 3 pp.
Sandy Hook	1977-1991		Miller, Thomas W. 1991. The official hawk watch at Sandy Hook, New Jersey, spring 1991. Cape May Bird Observatory, P.O. Box 3, Cape May Point, NJ 08212.
Sandy Hook			Bouton, Jeffrey J. 1987. The official hawk watch at Sandy Hook, New Jersey, spring 1987. Cape May Bird Observatory, P.O. Box 3, Cape May Point, NJ 08212.
			Chevalier, Sammy. 1988. Snowy owl populations at Kennedy International Airport, New York: A twenty-three year study. North American Bird Bander. 13 1: 2-3.
Fort Tilden	1990-1994		Walter, Steve. 1995. Fort Tilden 1994 hawk watch summary.
Sandy Hook			Clark, Kathleen E., Jenkins, C. David =, Jr. 1995. Osprey nesting and success in New Jersey, 1995. State of New Jersey, Department of Environmental Protection, Division of Fish, Game and Wildlife, New Jersey.

Species-Habitat Relationships

Raptors confirmed nesting in or near the grasslands at Floyd Bennett Field include the Northern harrier, American kestrel, and common barn-owl. Overwintering grassland birds at Floyd Bennett Field include northern harrier, rough-legged hawk (*Buteo lagopus*), American kestrel, common barn-owl, and short-eared owl.

There have been at least four pairs of osprey nesting in the JB NWR in recent years. Also, peregrine falcon nest on the Marine Parkway Bridge and feed throughout the bay.

Monitoring Programs at or near GATE

Breezy Point Hawk Banding Station

Breezy Point is a concentration area for raptors, especially during the summer and fall migrations. The raptor banding station at Breezy Point banded a total of 2,414 raptors during the period from 1978 to 1987 and sighted a total of 15,715 raptors. The most numerous species sighted were American kestrel (*Falco sparverius*) and sharp-shinned hawk (*Accipiter striatus*) with a total of 9,244 and 4,373 birds, respectively, sighted during that period. Other species consistently sighted include Cooper's hawk, northern harrier, osprey, peregrine falcon, and merlin (*Falco columbarius*). This data will be entered into NPSpecies.

Fort Tilden Hawk Watch

The Fort Tilden Hawk Watch was founded in 1990 and was covered full time during the 1991 through 1995 fall seasons. It is located on the Rockaway peninsula, about 2-3 miles away from the western tip of Long Island's south shore. The purpose of its establishment was for comparison to the Fire Island Hawk Watch, 40 miles to the east, and consequently, to learn more

about the movement of hawks on Long Island. Nature Bib lists a published report for this project and notes that separate summaries were compiled for each year. This report was written by Steve Walter and is titled 1991-1995 Fort Tilden Hawk Watch Summary.

Numbers of Osprey, Northern Harrier, Sharp-shinned Hawk, Cooper's hawk, and Buteos were found to be greater at Fort Tilden. These species generally follow the shore and numbers are likely augmented westward on Long Island by birds arriving from the mainland. Numbers of Merlin and Peregrine Falcon were found to be greater at Fire Island; these species don't hesitate to fly over open water and often depart Long Island for New Jersey before reaching Fort Tilden. American Kestrel numbers were usually similar, indicating that shore following individuals arriving on eastern Long Island follow the land strip as long as possible. Of interest, however, was the finding of a lag, often 2 weeks, between the peak of Kestrel migration at Fire Island and the peak at Fort Tilden. In addition to hawks, dragonflies and butterflies were also sampled and counted during this watch. Fourteen species of dragonflies were tallied, some not previously documented as migrants.

Sandy Hook Hawk Watch

The Sandy Hook Hawk Watch began in 1979 under the guidance of Cape May Bird Observatory with funding from the U.S. Fish and Wildlife Service. The old hawk watch site was on the mortar battery near the lighthouse but is now too overgrown with vegetation. It was conducted annually until 1994. It was restarted in 1999. Currently, the New Jersey Audubon's Owl Haven Nature Center conducts the Watch from March 15 to May 15 at Fort Hancock on the observation platform overlooking North Pond and the tip of Sandy Hook, near Parking Lot K. Nineteen species of diurnal raptors have been recorded for the Sandy Hook Hawk Watch, with over 10,000 migrating hawks passing by during the spring of 1985. Rarities have included Swallow-tailed Kite, Mississippi Kite, Swainson's hawk, Golden Eagle, and Northern Goshawk. More typical yearly totals range from 5,000 to 8,000 birds of prey. The bulk of the flights consist of Sharp-shinned (*Accipiter striatus*), Cooper's Hawks (*Accipiter cooperii*), American Kestrel (*Falco sparverius*), Merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), red-shouldered hawk (*Buteo lineatus*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), and osprey. Short-eared and Barn Owls have also been recorded. Mid-April tends to be the peak time for large flights, but good counts can continue into May.

Other monitoring programs at GATE and adjacent lands that are listed in Nature BIB include S. Chevalier Snowy Owl populations at Kennedy Airport, unknown date; J. Griffin Osprey and nesting bird report (1974 and 1975); Barn Owl nesting project, 1984; Karen Salesman Osprey breeding Success Program, 1989.

GEWA

Monitoring Programs at or near GEWA

Bald Eagle nesting success and eagle abundance

A monitoring program for nesting success and eagle abundance is conducted at GEWA. As of spring 2002, two active nests were located at GEWA. Nature Bib also lists a monitoring program for nesting activity of Bald Eagles from 1977 through 1995 at GEWA.

CBC

Species listed on the CBC's from 1936-1941 include the Bald eagle, Turkey Vulture, sharp-shinned hawk and Cooper's hawk. No other raptor inventories or monitoring programs have been conducted at GEWA.

SAHI

Monitoring Programs at or near SAHI

Aside from the BBA that also includes other areas outside of SAHI, no raptor inventories or monitoring programs have ever been conducted at SAHI.

THST

Monitoring Programs at or near THST

BBS data

BBS data (1966-2001) from LaPlata, Maryland located near THST lists Red-shouldered Hawk, Red-tailed Hawk, Cooper's hawk (1969 only), Broad-winged Hawk, American kestrel, Eastern screech-owl (1982 only), Great Horned Owl (1997 only) and Barred Owl as present.

CBC

A CBC completed in 1959 at Port Tobacco, Maryland where THST is located listed Black and Turkey Vultures, Sharp-shinned Hawk, red-shouldered Hawk, peregrine falcon, Great-horned Owl and Barred Owl as present. Other CBC's completed in 1979 and 1987-1994 do not list these species.

Section V.6. Grassland/Shrubland Birds

Introduction to Grassland Birds and their habitats in the Northeast and Mid-Atlantic Regions

Grasslands are open lands dominated primarily by grasses (*Gramineae*) and grass-like plants. Shrublands are open lands with a relatively high coverage of short, woody vegetation such as shrubs and saplings. Prior to European settlement, populations of Native Americans maintained open grasslands as relatively small patches within a forested landscape. In the years following European settlement, open grasslands increased as forested lands were cleared for agriculture. Open lands reached their zenith in the nineteenth century when vast areas of forest were cleared throughout northeastern North America.

Today, prominent grassland and shrubland habitats within the Mid-Atlantic region are primarily derived from agricultural fields and pasturelands. Additional grasslands occur as airport infields, transportation rights-of-way, industrial brown fields, municipal parks and urban areas. Additional shrublands occur as maritime thickets, utility rights-of-way and regeneration pine plantations. Some of the most significant open habitats within the region are located on public lands such as national parks (Watts, 2001). In the Northeast, grassland birds are now generally reduced to nesting in airports, small remnant hayfields and pasture meadows (Jones and Vickery 1997).

Throughout the twentieth century, the availability of open, idle lands has declined precipitously across northeastern North America. Initially, this decline was due to secondary succession on lands cleared during the previous century. More recently, urban sprawl has been responsible for the conversion of large tracts of land to residential and industrial use (Watts, 2001). Grassland habitat in New England and New York has declined by 60% during the past 60 years, as a result of abandoned agriculture, succession, and more recent development (US Dept. of Agriculture, cited in Vickery et al. 1997, Askins 1993).

As the quantity of open land continues to decline, an increasing proportion of the remaining area is being fragmented into small isolated patches. The result of the fragmentation is that the majority of open habitats within the region exist as small, ephemeral patches. Large open patches that are maintained for long periods of time are relatively rare within the landscape. An investigation conducted within coastal Virginia has shown that 95% of grassland and shrubland patches are less than 10 ha in area.

Annual BBS trends have indicated declines in grassland-dependent bird species concurrent with grassland habitat loss. Grassland birds now constitute a disproportionate number of State-Listed Endangered, Threatened, and Special Concern species in New England and New York (Vickery 1992). Additionally, species associated with open habitats have experienced some of the highest rates of population decline of any species group within the mid-Atlantic region (Watts, 2001).

Declining species represent a comparatively high proportion of the overall community within these habitat types. In Virginia, five of twelve bird species listed as Endangered depend on open

lands for breeding. In recognition of the continuing population declines, Partners in Flight has listed grassland/shrubland as one of the top priority habitats for conservation action.

Due to concern over their declining grassland bird numbers, the Massachusetts Audubon Society conducted a regional (i.e. e. New York and New England) survey of grassland birds during the 1997 breeding season. Both Vesper (*Poocetes gramineus*) and Grasshopper (*Ammodromus savannarum*) sparrows were considered very uncommon, detected in <15% of points surveyed. Of the seven states surveyed, Massachusetts was second to Maine in numbers of Vesper Sparrows, and was also important for Grasshopper sparrows (Shriver et al. 1997).

The Grasshopper sparrow and the Vesper sparrow are currently listed as Threatened Species by the Commonwealth of Massachusetts, and are similarly listed by other states in the region. Their decline is the result of habitat loss due to a number of factors.

Thus, while the initial decline of these species represents a decline from an anthropogenically-enhanced peak, since there is ample evidence that populations of these species were present at the time of European colonization, total decline would represent extirpation of a native species.

ASIS

Monitoring Programs at or near ASIS

Breeding:

BBA, BBS

Historically, a BBA that occurred at Assateague National Seashore. Currently, the BBS occurs at Chincoteague NWR at the southern end of Assateague Island.

Wintering:

CBC

The CBC occurs at Chincoteague NWR at the southern end of Assateague Island.

No known long-term monitoring program focusing on birds using grassland or shrubland habitats has occurred at ASIS.

CACO

Species-Habitat Relationships

The remaining significant grassland habitat in Massachusetts is found mainly in the Connecticut River Valley and the coastal sandplains of Cape Cod including CACO (Shriver et al. 1997, Jones and Vickery 1997). Based on the statewide surveys conducted from 1993 to 1995, Cape Cod, with its expanses of heathlands and coastal sandplains, emerges as important in the regional survival of grassland nesting birds.

Grasshopper sparrows are rare and local nesters on the Cape, confirmed only at the Crane Wildlife Management Area in Falmouth, and Otis Air Force Base (Veit and Petersen 1993). However, in 1963, at least 10 pairs nested at Fort Hill, with scattered pairs in Truro and Wellfleet

(Bailey 1968). In 1965 their distribution was recorded in suitable habitat over the entire Cape out to North Truro, although numbers indicated decline since the 1930's (Hill 1965).

Breeding Grasshopper Sparrows were not recorded in a 1993-1995 state survey at CACO or in a repeat survey in 2000 at CACO. It is now thought that they may be extirpated from the park. However, it is noted that Grasshopper Sparrows are secretive birds with a cryptic call that could be easily overlooked (Bailey 1968, Bent 1968, Forbush 1929). The habitat of these sparrows is also transitory, and loose colonies of the birds tend to appear and disappear abruptly (Veit and Petersen 1993, Bailey 1968).

During the 1993-1995 statewide survey, Vesper Sparrows were found to be widely distributed, but in small numbers across the state (Jones and Vickery 1997). Vesper Sparrows are also rare and local nesters on Cape Cod (Veit and Petersen 1993). In 1965 they were recorded as scattered pairs of about 20 in Chatham-Orleans and 20-25 in North Truro, but they had been decreasing in numbers since the 1930's, paralleling the eastward extension of the forest (Hill 1965).

In the 1993-1995 survey, CACO was found to have significant nesting habitat for these birds, accounting for 25% (34 of 132) of all Vesper Sparrows recorded statewide. Important areas were the sand dunes that run from Provincetown to Truro, Provincetown Airport, Marconi Barrens in Wellfleet, and Griffin's Island in Wellfleet (Massachusetts Audubon Society 1995, Jones and Vickery 1997). A repeat of this survey was conducted in 2000 at CACO. Whereas 34 singing males were recorded from four sites in the mid-1990's, a total of 17 were recorded from two sites in 2000.

Of the coastal grassland /heathland habitat in Cape Cod National Seashore, 450 ha (62%) of heathland have disappeared between 1962-1985 (Carlson et al. 1992). This loss of habitat seems to be increasing in rate due to the encroachment of pitch pine and scrub oak. Management options suggested by Carlson et al. (1992) include no action, burning, mowing, clipping followed by herbicide treatment, and grazing. "No action" is the management option that has led to the observed succession from heathland to forest over the past 30 years. Heathlands are relatively rare in the United States, and are mentioned in the General Management Plan for Cape Cod National Seashore as important plant communities to be preserved (NPS 1996).

COLO

Species-Habitat Relationships

Bryan Watts of the Center for Conservation Biology at the College of William and Mary wrote *Management of Park Fields to Enhance the Natural Resource Value and Diversity of Colonial National Park* (Watts, 2001). The following are excerpts from that manual.

COLO currently supports 177 patches of open habitat that cover 378.9 ha (935.9 acres) of land. These patches vary in size from very small fragments that cover less than one tenth of 1 ha to larger patches more than 30 ha (74 acres) in area. The majority (76.8%) of patches are less than 2 ha (5 acres) in size. Most of these smaller patches are positioned along roadways and have a very linear shape.

A portion of these open habitat patches found within COLO have the potential to support populations of species that are of conservation concern within the mid-Atlantic region. Under the current management regime, open lands do not provide the habitat conditions required by species of conservation concern. A shift from the current to recommended management regime would provide a sustainable source of habitat capable of supporting an estimated 1,453 breeding pairs of open-habitat bird species. This management shift would result in estimated savings in maintenance costs of more than \$250,000 over a ten-year period.

This manual provides an excellent source for maximizing bird use of grasslands by changing management techniques. In addition, it discusses how certain open grasslands within COLO may have more potential than others of supporting significant populations of grassland bird species. This manual may be a useful reference for other C&B park managers. Bryan Watts is currently a cooperator working on several NPS parks within the region. His colleague, Dana Bradshaw, at the Center for Conservation Biology, has completed many years of the BBS at COLO.

Monitoring Programs at or near COLO

Breeding:

BBS

The BBS is conducted annually in COLO along Colonial Parkway and data maps from the VA Breeding Birds Atlas may be available within a few months.

Wintering:

CBC

In addition, CBC's are conducted annually.

No known long-term monitoring program focusing on birds using grassland or shrubland habitats has occurred at COLO.

GATE

Species-Habitat Relationships

Currently, in NY urban and suburban areas, grasslands that are maintained as parts of parks, airports, or other facilities have become increasingly important to grassland bird species such as the Floyd Bennett Field in Jamaica Bay at GATE. This area includes the upland and shoreline of the civil aviation facility that was largely created by the filling of salt marsh islands in the bay.

The airfield was decommissioned in 1950 and became a haven for grassland and open-country birds until the last several decades when succession of open areas into shrub and developing forest eliminated habitat.

In 1985, a portion of Floyd Bennett Field was restored to grassland and now about 57 hectares (140 acres) are maintained through clearing, mowing, and burning. This is one of the few sizable grasslands within the urban core of New York City; it supports a variety of grassland birds, several of which are rare and/or declining in the northeastern United States. Close monitoring of bird populations using this area has occurred since the Floyd Bennett Field restoration.

Grassland birds confirmed nesting in the Floyd Bennett Field grasslands in recent years include grasshopper sparrow, horned lark (*Eremophila alpestris*), eastern meadowlark (*Sturnella magna*), upland sandpiper, savannah sparrow (*Passerculus sandwichensis*), northern harrier, American kestrel, and common barn-owl. Bobolink (*Dolichonyx oryzivorus*) is a regular migrant visitor in the grasslands. Grassland birds, especially upland sandpiper, also utilize the grassland habitat along the runways at John F. Kennedy Airport, which is close by Floyd Bennett Field.

Use of Floyd Bennett Field by grasshopper sparrows increased significantly in average abundance and shifted their distribution into the grassland management area between 1984 and 1992. However, in 1996, there were no grasshopper sparrows nesting at Floyd Bennett Field, but there were 22 pairs of savannah sparrow. In recent years, there have also been two nesting locations for American oystercatcher along the northeast shoreline of Floyd Bennett Field.

Overwintering grassland birds at Floyd Bennett Field include northern harrier, rough-legged hawk (*Buteo lagopus*), American kestrel, common barn-owl, short-eared owl, horned lark, eastern meadowlark, and savannah sparrow.

Table2-23. Grassland Bird Inventories of GATE

Location in Park	Year(s)	Status	Bibliography
<i>Jamaica Bay</i>	<i>Unknown</i>	<i>U</i>	Weickert, T., Ahern, J. No Date. Ring-necked pheasant population studies at the Jamaica Bay Unit of Gateway National Park. Gateway Institute for Natural Resource Sciences, Gateway National Recreation Area, National Park Service, GATE-N-011-11, Staten Island, NY.
<i>Sandy Hook</i>	<i>1982</i>	<i>B</i>	Wander, Wade. 1982. Breeding status of grassland birds in New Jersey. Records of New Jersey Birds. 8 1: 2 - 4.
<i>Floyd Bennett Field</i>	<i>1998</i>	<i>B</i>	Elbin, Susan B.Koontz, Fred W., Koontz, Fred W. 1998. Status of Grassland Birds Breeding on Restored Grasslands at Floyd Bennett Field, Gateway National Recreation Area. Wildlife Conservation Society, Bronx, New York.

Monitoring Programs at or near GATE

Data from the R.A. Lent's 1996 Bird-habitat relationships as a guide to ecologically-based management at Floyd Bennett Field, Gateway National Recreation Area studies has been obtained and will be entered into the NPSpecies. An additional 1998 report completed by Susan Elbin of the Wildlife Conservation Society titled *Grassland Birds at Floyd Bennett Field* will be requested from GATE staff for entry into NPSpecies. This report provides data regarding breeding grassland species at Floyd Bennett field in 1996 and 1997. It also described trends in grassland birds using this area from 1985 through 1997.

FIIS

Species-Habitat Relationships

The upland grassland community of the William Floyd Estate provides habitat for breeding American woodcock (*Scolopax minor*). This is a species currently being monitored by NYDEC. This habitat also supports a variety of migrating and nesting songbirds. This area is one of the few remaining sites on the south shore of Long Island where tidal wetlands are contiguous with an undeveloped upland buffer.

Monitoring Programs at or near FIIS

BBA

The BBA is conducted at FIIS and data is available from this project.

CBC

Two CBC's are conducted annually.

No known long-term monitoring program focusing on birds using grassland or shrubland habitats has occurred at FIIS

GEWA

The park habitats include about 280 acres of open grasslands (pasture and mowed) and 18 acres of memorial cultural landscapes. Considering the extent of open grasslands and their predominance as a habitat a GEWA, and the extent of marshes, it appears that an initial inventory of grassland bird species is warranted to determine the need for a long-term monitoring program. Currently, Dana Bradshaw of The Center is conducting an inventory for Conservation Biology at the College of William and Mary to determine if there is a need for long-term monitoring of grassland bird species at this park.

An annual CBC is conducted at GEWA. No monitoring programs for grassland or shrubland species have ever occurred at GEWA

SAHI

Habitats include approximately 10 acres of mowed lawns (10 acres) and about 12 acres of rough fields. Currently, TRS is conducting a bird inventory to determine the need for possible long-term monitoring of any bird species utilizing these habitats.

No monitoring programs for grassland birds have ever occurred at SAHI.

THST

THST habitats include approximately 20 ha of fields. Currently, Dana Bradshaw of The Center is conducting an inventory for Conservation Biology at the College of William and Mary to determine if there is a need for long-term monitoring of grassland bird species at this park.

Monitoring Programs at or near THST

No monitoring programs for grassland bird's species have ever been conducted at THSDT.

Section V.7. Marsh Birds

ASIS

Monitoring Programs at or near ASIS

NRBIB lists a Marsh Bird Monitoring Program conducted by David Brinker in 1990 and a Clapper Rail Banding Project conducted in 1977. (Stotts, Vernon D. 1977. Clapper Rail Banding Project.) In addition a BBA occurred at Assateague National Seashore, the BBS and CBC occur at Chincoteague NWR at the southern end of Assateague Island.

CACO

Species-Habitat Relationships

A salt marsh and grassland monitoring study was recently conducted by the Massachusetts Audubon Society and included 10 sites at CACO. This study confirmed the presence of seven, of the targeted eleven, marsh bird species (American Bittern, American Coot, King Rail, Least Bittern, Pied-billed Grebe, Sora, and Virginia Rail) at CACO. Six of these were documented from calls elicited by tape playback, the other, the American Coot, was identified visually. The most commonly detected marsh birds were Sora (n=15), Pied-billed Grebe (n=13), and Virginia Rail (n=12). Great Pond, Provincetown (n=22) and Hatches Harbor Inside Dike (n=15) were the most common locations.

Additionally, records were kept of other species that use CACO wetlands and are under-sampled by other monitoring programs. Thirteen of these “secondary” species were recorded at nine of the eleven monitoring wetlands. Common Yellowthroats (n=167) were by far the most commonly recorded, with Marsh Wrens (n=23), Belted Kingfishers (n=16), Northern Harriers (n=6), and several species of waterfowl also recorded.

Wood End (6 survey points) and Pleasant Bay (5 points) had no target or secondary species observations, and Great Island (4 points) had only one secondary species observation (Belted Kingfisher). Conversely, Great Pond/Lily Pond, Provincetown (5 points) and the Pamet River (8 points) had 82 and 80 observations respectively.

Further, freshwater/brackish wetlands held 54 of the 57 target species records. The exceptions being American Bitterns observed once in Nauset Marsh and twice in Hatches Harbor Outside dike.

Throughout all aspects of the study only one individual was documented (a Pied-billed Grebe at Great Pond, Provincetown) during the initial passive 5-minute phase of the tape.

Of the twenty-two individuals that responded vocally to the tape, sixteen were recorded as within 50m of the survey point, five as outside 50m, and one that moved from outside to inside during the tape playback.

COLO

Species-Habitat Relationships

Within this park's habitats are 2482 acres of wetlands and 3061 acres of floodplain, which may be suitable for marsh birds. Mature deciduous and Loblolly Pine forests bound Saltmarsh tributaries on the eastern portion of the Parkway. The western end of the Parkway to Jamestown parallels the brackish James River, crossing several brackish to freshwater creeks and marshes.

Monitoring Programs at or near COLO

The BBS is conducted annually in COLO along Colonial Parkway and data maps from the VA Breeding Birds Atlas may be available within a few months. In addition, CBC's are conducted annually.

FIIS

Species-Habitat Relationships

West Inlet Island: Seaside and sharp-tailed sparrows (*Ammodramus Maritimes* and *A. caudacutus*), clapper rail (*Rallus longirostris*), and green-backed heron (*Butorides striatus*) nest in adjacent salt marshes.

The upland community of the William Floyd Estate provides habitat for breeding American woodcock (*Scolopax minor*) and a variety of migrating and nesting songbirds, while adjacent tidal areas afford habitat for nesting American bittern (*Botarus lentiginosus*), seaside sparrow, and osprey. This area is one of the few remaining sites on the south shore of Long Island where tidal wetlands are contiguous with an undeveloped upland buffer.

Monitoring Programs at or near FIIS

Comprehensive Monitoring Study at Wm. Floyd Estate

Currently, a cooperative effort with USGS/USFWS/Moriches Bay Audubon Society at the Wm. Floyd Estate is underway to conduct annual surveys that include water tables, salinity levels, vegetation characteristics, invertebrate surveys including mosquitoes, waterfowl surveys and fish surveys. Data collection began in the fall of 1999. A brief summary of species data was completed by Ernest Taylor and will be entered into NPSpecies.

Salt marsh bird surveys were conducted from May 2000 through April 2001. These surveys were conducted to monitor the effects of salt marsh restoration on the bird community within the marsh. The objectives of this bird monitoring program are, first, to estimate trends in population sizes for birds in the salt marsh at different times of the year (i.e., breeding, winter, migrating); second, to examine if changes or trends in the bird population can be attributed to changes in the salt marsh structure due to recent restoration.

A total of 741 individual birds of 56 species and 8 groups not identified to species were observed on transects from May 2000 to April 2001. Because of the difficulty in identifying some types of birds to species (in particular, the small sandpipers), 6 categories containing multiple but similar species were created for analysis. These categories were Cormorants (containing Double-crested cormorants and potentially other cormorant species); Ducks (a grouping containing

mostly Black ducks, but also Mallards and several other ducks seen in flight); Gulls (containing Greater black-backed gulls, possibly Lesser black-backed gulls, Herring gulls, and Ring-billed gulls); Marsh sparrows (Seaside and Sharp-tailed sparrows); small sandpipers (containing the morphologically similar Least, Semi-palmated, and Western sandpipers); Swallows (containing mostly Tree swallows but also Barn swallows); and Terns (containing a variety of tern species, but mostly Common terns). This data has been obtained and will be entered into NPSpecies.

GEWA

The park habitats include about 25 acres of freshwater and brackish marshes.

Monitoring Programs at or near GEWA

No monitoring programs for grassland species have ever occurred at GEWA. Considering the extent of open grasslands and their predominance as a habitat at GEWA, and the extent of marshes, it appears that an initial inventory of grassland bird species is warranted to determine the need for a long-term monitoring program.

SAHI

Species-Habitat Relationships

Habitats include approximately 10 acres of mowed lawns (10 acres), about 12 acres of rough fields and 10 acres of saltmarsh. In 1997, a habitat assessment was conducted at SAHI (Kiviat, 1997). Survey recommendations included in this report were to conduct a breeding bird survey in the beach-marsh complex. It was noted that the saltmarsh had potential for providing nesting habitat for seaside sparrow, black rail and other marsh nesting birds. Currently, TRS is conducting an inventory of this habitat to determine the need for possible long-term monitoring of any bird species utilizing this saltmarsh.

Monitoring Programs at or near SAHI

No monitoring programs for marsh birds have ever occurred at SAHI.

THST

Habitats may include some freshwater marsh near the Hog Run stream. No monitoring programs for marsh birds species has ever been conducted at THSDT.

Section V. 8. Seabirds

Seabirds found along the Atlantic Coast

Seabirds are those birds that spend most of their lives on the open waters of the ocean, coming to land only to breed. This group is composed of members of several different bird families, and may be broadly lumped into two subgroups based on distribution: a coastal or nearshore group that is most common within about three miles of land and includes the sea ducks, loons, grebes, and gulls; and a pelagic or oceanic group (pelagic birds) that generally occurs farther offshore, out of sight of land, and includes shearwaters, petrels, fulmars, gannets, phalaropes, skuas, kittiwakes, jaegers, and auks. Other waterbirds such as terns and cormorants that are associated with the sea, but that occur primarily in bays and on land during the non-breeding period are not included here.

On a continental basis there are 15 species that are classified as seaducks and all are in the Tribe Mergini (Elliot 1997). In the Chesapeake Bay area, common seaducks are the scoters (black, surf, and white-winged) and oldsquaw (now called long-tailed duck). Eiders and harlequin ducks also are seaducks, but because of their low numbers are not typically seen in the Bay. Although the common eider is more abundant in New England and the Maritimes, the harlequin duck is very rare and is possibly close to being threatened on the Atlantic coast. The three species of mergansers (common, red-breasted, and hooded), the bufflehead, and the common goldeneye are also considered seaducks by the Seaduck Joint Venture, and are commonly seen in the Bay. The Barrow's goldeneye is very rare in the Atlantic Flyway.

Seaducks on the Chesapeake Bay have received more attention in recent years as hunters have increased hunting pressure on these species, mostly due to closed seasons on Canada geese (Perry and Deller 1994). Hunting pressure could influence the distribution and abundance of seaducks. Hunting could become a more serious problem in the future for seaducks in combination with the habitat problems in the Bay.

The location of the breeding and molting areas of some species of seaducks is uncertain and in need of further study. The black scoter is of special concern, because it is both the least common of the three scoter species and the species least studied (Kehoe 1994). The Continental Technical Team of the Sea Duck Joint Venture has recommended new research on seaducks to learn more about their movements to breeding and molting areas. Satellite tracking of scoters instrumented in late winter on the Chesapeake Bay will provide new information that will be beneficial to protecting critical breeding and molting habitat of these species and improving future management of their populations.

The U.S. Fish and Wildlife Service (Region 5) recently provided funding to the USGS Patuxent Wildlife Research Center (Laurel, MD) to conduct research on seaducks that breed in the Northeast and winter in Chesapeake Bay. The location of the breeding and molting areas of seaducks is uncertain and in need of further study. Although data will be collected on all species

of seaducks, major emphasis will be on the scoters (black, surf, and white-winged), because little is known about this group of ducks.

The data obtained from the satellite tracking will enable managers in Canada to learn more about the areas being used by these ducks as breeding and molting habitats. The food habits and wintering ecology studies will provide more information on the important wintering habitat of the seaducks. By knowing more about these critical areas managers can provide optimum protection to these habitats and the seaducks dependent on them.

For further information contact: Matt_Perry@usgs.gov

A study with results possibly leading to long-term monitoring along Northeast parks was conducted by the USFWS beginning in 1998 offshore of ASIS to determine the levels of mercury in the blood and feathers of common loons and to determine if levels of mercury found in the feathers of breeding adult loons from the Northeast US can be partly explained by mercury uptake on wintering areas. Results indicated mercury levels in blood and feathers of common loons wintering in Chesapeake Bay are low compared to levels found in breeding adults from the Northeast. It appears that the Chesapeake Bay population of wintering common loons do not breed in the Northeast US. From wing-loading coefficient calculations and morphometric measurements, Chesapeake Bay birds most likely breed in Quebec and/or the Great Lakes. No future sampling in Chesapeake Bay anticipated for this project. Winter capture efforts have moved to the New England coast.

Bird Carcass Monitoring on Beaches

Volunteer groups, such as the Coastal Observation and Seabird Survey Team (COASST) administered by the University of Washington, have monitored beaches on the Pacific coast for bird carcasses over the past several years. Bird carcasses can provide useful information about the state of the coastal environment. Weather, fisheries, coastal habitat change, gillnetting and even feral cats and dogs can affect bird populations. Some species, like the Common Murre, are so sensitive to environmental and human-induced events; they are the ‘canary-in-the-coalmine’ for Pacific Northwest coastal ecosystems.

These monitoring programs provide data that create a baseline, or the ‘normal’ pattern of beached bird mortality. Armed with this information, unusual events such as increased mortality during an El Niño year can be noted. Should a human-mediated event, like an oil spill, happen, data could be used to determine the percent increase in mortality from background levels. In addition, data from these monitoring programs have been used to determine seabird mortality due gillnetting which aiding in changing regulatory use of gillnets.

This data can also determine the rate of scavenging and how long carcasses persist on the beach. This baseline information can be used for a variety of science and natural resource management goals. Perhaps most importantly, this data can be used to identify long-term changes in the status of our resident marine bird populations.

COASST is a citizen-science program that identifies carcasses of marine birds found on beaches along on the outer coast of Washington State. As part of this program, pairs of specially trained

COASST volunteers conduct monthly or bi-monthly surveys of a particular stretch of coastline, usually 1 to 4 kilometers in length. At a minimum, each carcass is measured, identified, photographed, marked individually, and left in place. It's website is www.coasst.org. Similar monitoring programs include Beach Watch administered by Gulf of Farallones National Marine Sanctuary at www.farallones.nos.noaa.gov; Beach Combers administered by Monterey Bay National Marine Sanctuary at www.mbnms.nos.noaa.gov.

ASIS

Prior Inventories at ASIS

In 1998, The U.S. Fish and Wildlife Service began long-term a study to assess bird mortality in nearshore anchored gillnets in the ocean off New Jersey, Delaware, Maryland, Virginia and North Carolina which included ASIS as one of its' study sites. The study employed four components: Observation of net retrievals; counting dead birds along beaches; aerial surveys for birds and nets; and counting live birds along the shore out to 400 meters offshore.

Work on Assateague Island National Seashore involved 8 weekly censuses of the coast from Ocean City Inlet to the south boundary. Eight Surveys were conducted along ocean beaches from 12 March through 21 April 1998. Birds on the water were counted to 400 m offshore and shorebirds and gulls along the beach were also counted. The data was combined with surveys along 20 other beaches from Cape Hatteras to New Jersey to derive indicators of how gillnets reduce bird populations and for baseline data for future use.

Species-Habitat Relationships

Results from the USFWS study on ASIS listed twenty-four species of birds observed on the water with double-crested cormorants, black scoters, common loons, and red-throated loons the most abundant. Nine species of shorebirds were observed with sanderlings and willets the most abundant. The most abundant gulls were ring-billed and herring gulls. Up to 12 harlequin ducks were seen regularly at the jetty at the north end of the park. Harlequins are endangered in Canada and a species of special concern in the U.S.

FIIS/GATE

Species Habitat Relationships

In New York, gulls, sea ducks, loons, and grebes dominate coastal waters during the winter. Two species of loons, common loon (*Gavia immer*) and red-throated loon, migrate through and winter in the New York Bight. These birds winter in both the pelagic and coastal zones of the Bight and also occur in coastal bays. Loons feed primarily on fish, but also feed on crustaceans, insects, and mollusks. Two species of grebes, horned grebe (*Podiceps auritus*) and red-necked grebe (*Podiceps grisegena*), also frequent the nearshore waters and coastal bays. Sea ducks, including black, white-winged, and surf scoters (*Melanitta nigra*, *M. fusca*, and *M. perspicillata*) and oldsquaw (*Clangula hyemalis*), are widely distributed in low numbers in the coastal waters of the New York Bight. Common eider (*Somateria mollissima*), king eider (*Somateria*

spectabilis), and harlequin duck (*Histrionicus histrionicus*) primarily winter off rocky coasts to the north of the New York Bight, but the common eider appears to be expanding its wintering range to the south into the Bight, and harlequins and king eiders regularly occur off Montauk Point. Two species of gulls that breed in the New York Bight watershed, the herring gull (*Larus argentatus*) and greater black-backed gull (*Larus marinus*), are abundant in winter in the bays, coastal waters, and offshore waters of the New York Bight.

Major threats to pelagic birds include oil spills and impacts to water quality, other factors that affect their food base, such as over harvesting of fish. There is a great deal of tanker traffic in the New York Bight and the practice of lightering (transferring oil from large tankers to smaller ships) in the Bight outside of the New York - New Jersey Harbor increases the risk of a spill. An oil spill in the New York Bight would have both direct and indirect impacts on all species of seabirds. Other activities on the continental shelf, such as ocean dumping and sand mining, could directly or indirectly impact pelagic birds. Impacts to the coastal fisheries populations from pollution, over harvest, and other factors in the coastal bays and estuaries of the New York Bight will also affect those pelagic and coastal birds that depend upon these fish and invertebrates for food.

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APPENDIX A

Table A-1. PIF Northeast Priority Bird Species by Habitat

Habitat	Species	Action level	CACO	FIIS	GATE JBNR	SAHI
Maritime Marshes	Saltmarsh Sharp-tailed Sparrow	II	X	X-b	X	
	Black Rail	II	X		X	
	Seaside Sparrow	IV	X	X-b	X-b	
	American Black Duck	II	X	X-b	X-b	
	American Bittern	IV	X	X	X	
	Tricolored Heron	V	X	X	X-b	
	Northern Harrier	IV		X-b	X-b	
	Glossy Ibis	V	X	X-b	X-b	
	Black-Crowned Night Heron	V	X	X-b	X-b	
	Yellow-Crowned Night Heron	V	X	X	X-b	
	Osprey	V		X	X-b	X
	Great Egret	V	X	X-b	X-b	X
	Snowy Egret	V	X	X-b	X-b	X
	Little Blue Heron	V	X	X-b	X-b	
	Cattle Egret	V	X		X-b	
	(Short-eared Owl--NB)		X	X	X-b	
Beach/dune	Piping Plover	II	X-b	X-b	X-b	
	American Oystercatcher	IV	X	X-b	X-b	
	Roseate Tern	II	X-b	X-b	X-?	
	Short-eared Owl	IV	X	X	X-b	
	Common Tern	IV	X	X-b	X-b	X
	Least Tern	IV	X	X-b	X	
	Artic Tern	V	X		X	
	Horned Lark	V	X	X-b	X	
	(Ipswich Sparrow--NB)					
Mature deciduous and mixed forest	Cerulean Warbler	II	X	X	X	
	Wood Thrush	III	X	X	X	
	Worm-eating Warbler	IV	X	X	X	
	Baltimore Oriole	III	X	X	X	
	Black-billed Cuckoo	III		X-b	X	
	Black-throated Blue Warbler	IV	X	X	X	X
	Louisiana Waterthrush	IV	X	X	X	X
	Scarlet Tanager	III	X	X	X	X-b
	Kentucky Warbler	IV	X	X	X	X
	Rose-breasted Grosbeak	III	X	X		X-b
	Blackburnian Warbler	III	X	X	X	X

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	Canada Warbler	IV	X	X	X	
	Eastern Wood-pewee	III	X	X	X	X-b
	Black-and-white Warbler	III	X	X	X	X-b
	Northern Parula	IV	X	X	X	X
	Hairy Woodpecker	III	X	X	X	X-b
	Purple Finch	III	X	X	X	X
	Northern Goshawk	IV	X	X	X	
	Red-shouldered Hawk	IV	X		X	
	Long-eared Owl	IV	X	X	X	
	Sharp-shinned Hawk	IV	X	X	X	X
	Cooper's Hawk	IV	X	X	X	X
	Barred Owl	IV				
Early successional shrub/ Pitch Pine Barren						
	Golden-winged Warbler	II	X	X	X	
	Blue-winged Warbler	III	X	X	X	X
	Prairie Warbler	III	X	X	X	X-b
	American Woodcock	III	X	X-b	X-b	
	Chuck-will's widow	IV	X	X-b		
	Red-headed Woodpecker	IV	X	X	X	X
	Eastern Towhee	III	X	X-b	X	X-b
	Whip-poor-will	IV	X	X	X	
	Yellow-breasted Chat	IV	X	X-b	X	
Grassland/agricultural						
	Upland Sandpiper	III	X	X	X	
	Grasshopper Sparrow	III	X	X	X	
	Bobolink	IV	X	X	X	
	Vesper Sparrow	III	X	X	X	
	Northern Harrier	IV	X	X-b	X-b	
	Barn Owl?	IV	X	X	X	
	Savannah Sparrow	V	X	X	X	
	Horned Lark	V	X	X-b	X	
	(Short-eared Owl)		X	X-b	X-b	
Urban/suburban						
	Chimney Swift	III	X	X	X	X
	Peregrine Falcon	II		X	X-b	
	Purple Martin?	IV	X	X	X	
	Common Nighthawk	IV	X	X	X	X
Freshwater wetland (river/lake)						
	American Black Duck	II	X	X-b	X-b	
	King Rail	IV	X		X	
	American Bittern	IV	X	X	X	
	Least Bittern	IV	X		X	

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Northern Harrier	IV	X	X-b	X-b	
Osprey	IV	X	X	X-b	X
Pied-billed Grebe	V	X	X	X-b	
Common Moorhen	V	X		X-b	
Great Blue Heron	V	X	X	X-?	X

b=confirmed breeder

SAHI-bird species list from Theodore Roosevelt Audubon Sanctuary located approximately 1 mile to south of SAHI

GATE-species list from i-bird.com of Jamaica Bay NWR only

CACO-from NPSPecies LIST

Table A-2 PIF Mid-Atlantic Priority Bird Species By Habitat

Habitat	Species	Action ASIS level		THST	GEWA	COLO
Pine Savannah	Red-cockaded Woodpecker	I				?
	Prairie Warbler	IV	X	X		
	Bachman's Warbler	III				
	Brown-headed Nuthatch	IV	X-b			
	Eastern Wood-peewee	IV	X-b	X		X
	Red-headed Woodpecker	VI	X-b	X		X
	American Kestrel	IV	X	X		
	Chuck-will's-widow	V	X-b			
Barrier and Bay Islands	Piping Plover	IV	X-b			
	Roseate Tern	I	X			
	American Black Duck	III		X		
	Wilson's Plover	IV	X-b			
	Brown Pelican	VI				
	American Oystercatcher	III	X-b			
	Black Skimmer	III	X-b			
	Least Tern	IV	X-b			
	Gull-billed Tern	III	X			
	Willet	VI	X-b			
	Forster's Tern	VI	X-b			
	Royal Tern	IV	X-b			X
	Tricolored Heron	VI	X			
	Glossy Ibis	VI	X			
	Northern Harrier	VI	X-b			
	Little Blue Heron	VI	X			
	Yellow-crowned Night Heron	VI	X			
	Great Egret	VI	X			X
	Caspian Tern	VI	X			
	Sandwich Tern	VI	X			
	Ipswich Savannah Sparrow	VI				
Salt Marsh	Salt Marsh Sharp-tailed Sparrow	IV	X-b			
	Black Rail	V	X MD-NC			
	Prairie Warbler	IV	X-b			
	Henslow's Sparrow	V	X			
	Seaside Sparrow	VI	X-b			
	Sedge Wren	VI	X			
	American Black Duck	III	X-b			
	Clapper rail	IV	X-b			
	Willet	VI	X-b			

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Forested Wetland	Short-eared Owl	V	X			
	Northern Harrier	VI	X-b			
	Cerulean Warbler	V	X			
	Swainson's Warbler	IV	X			
	Kentucky Warbler	IV	X	X		X
	Acadian Flycatcher	IV	X-b	X		X
	Yellow-throated Vireo	IV	X	X		X
	Prothonotary Warbler	IV	X	X		X
	Louisiana Waterthrush	IV	X	X		X
	Chimney Swift	VI	X-b	X		
	Red-shouldered Hawk	VI	X	X		X
	Great Blue Heron	VI	X	X	X	X
	Barred Owl	VI		X		
	Wayne's Bick-Thr-green Warbler	VI				
Mixed Upland Forest	Cerulean warbler	V	X			
	Wood Thrush	IV		X		X
	Kentucky Warbler	IV	X	X		X
	Acadian Flycatcher	IV	X-b	X		X
	Worm-eating Warbler	IV		X		
	Eastern Wood-pewee	IV	X-b	X		X
	Louisiana Waterthrush	IV	X	X		X
	Red-headed Woodpecker	VI	X-b	X		X
	Carolina Chickadee	VI	X-b	X		X
	Scarlet Tanager	VI	X	X		X
	Cooper's Hawk	VI	X			
	Red-shouldered Hawk	VI	X	X		X
	Barred Owl	IV		X		
Early Successional	Prairie Warbler	IV	X	X		
	Bachman's Sparrow	III				
	Henslow's Sparrow	III	X			
	Blue-winged Warbler	IV	X			
	Upland Sandpiper	III	X			
	White-eyed Vireo	IV	X-b	X		X
	Northern Bobwhite	IV	X-b	X		X
	Brown Thrasher	IV	X-b	X		X
	Eastern Towhee	IV	X-b	X		X
	Field Sparrow	IV	X-b	X		
	Barn Owl	III	X-b			
	Grasshopper Sparrow	IV	X	X		
	American Kestrel	IV	X	X		
	Gray Catbird	IV	X-b	X		X
	Yellow-breasted Chat	IV	X-b	X		X

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	Dickcissel	VI	X		
	Loggerhead Shrike	III			
	Short-eared Owl	VI	X		
	Bobolink	VI	X		
	Vesper Sparrow	IV	X	X	
	Northern Harrier	VI	X-b		
	Savannah Sparrow	VI	X		
Pine Plantation					
	Prairie Warbler	IV	X	X	
	Bachman's sparrow	III			
	Blue-winged Warbler	IV	X		
	Brown-headed Nuthatch	IV	X-b		
	Eastern Wood-pewee	IV	X-b	X	X
	White-eyed Vireo	IV	X-b	X	X
	Northern Bobwhite	IV	X-b	X	X
	Carolina Chickadee	VI	X-b	X	X
	Brown Thrasher	IV	X-b	X	X
	Eastern Towhee	IV	X-b	X	X
	Field Sparrow	IV	X-b	X	
	Gray Catbird	VI	X-b	X	X
	Yellow-breasted Chat	VI	X-b	X	X
Freshwater wetland					
	American Black Duck	III	X-b	X	
	King Rail	V	X		
	American Bittern	V	X MD-NC		
	Least Bittern	V	X-b MD-NC		
	Pied-billed Grebe	IV	X	X	X
	Common Moorhen	VI	X MD-NC		

b=confirmed breeder

ASIS-confirm breeders with BBA

THST-Probables found based on nearby BBS (1986-2001) and CBC (1987-2001); ?from volunteer list
COLO-BBS for Colonial parkway (1992);

Table A-3. Avian Monitoring Programs within the Coastal and Barrier Park Network

PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE
ASIS	Breeding Bird Atlas(BBA)		Database only	Maryland Ornithological Society	.
ASIS	Breeding Bird Survey: 1992-present	Chincoteague National Wildlife Refuge	Database only	USGS Patuxent Wildlife Research Center keeps the database	http://www.mp2-pwrc.usgs.gov/bbs
ASIS	Winter Bird Survey-6 years		report/database/maps	Maryland Dept Natural Resources	
ASIS	Fall Migrant Peregrine Falcon Surveys:1970-present		reports only	Dept. of the Army	
ASIS	Bald Eagle Mid Winter Surveys	Throughout Park	reports and database	USGS	
ASIS	Bald eagle Nest Monitoring		report only	Maryland Dept Natural Resources	
ASIS	Breeding Colonial Waterbirds:1985-present	Throughout Park		NPS staff and Maryland Dept Natural Resources	
ASIS	Piping Plover/Colonial Shorebird Breeding:1986-present	Beach/dune habitat	reports;database;GIS layer	NPS and CNWR refuge staff	
ASIS	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; MD Dept of Natural Resources	
ASIS	National Wildlife Refuge Data	Chincoteague National Wildlife Refuge	Database	USFWS	
ASIS	Kirkpatrick's Waterfowl Population Assessment:compilation of data from 1979-1992	Throughout Park	report and database		
ASIS	Northern Saw Whet Owl Monitoring:early 1990's-present	Exact banding site not noted	Database	Project Owl-net	
CACO	BBA		report only	Massachusetts Audubon Society	
PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE
CACO	Breeding Bird Survey		Database only	National Biological Service	http://www.mp2-pwrc.usgs.gov/bbs

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CACO	MAPS station (Monitoring Avian Productivity and Survivorship): 1999-2003		annual data collection, no formal summary, and data entered into collaborators database.	Institute for Bird Populations	http://www.birdpop.org/ maps.htm
CACO	Plot Counts of landbirds-2001- present		database	University of Massachusetts	
CACO	Christmas Bird Count: 1917;1950- 1953; 1996-2000		database only	National Audubon Society	http://www.audubon.org/ bird/cbc
CACO	Colonial Waterbirds breeding; migrating and wintering: present	Throughout Park		NPS staff (breeding CW work); PeterTrull (wintering and migrating CW work)	
CACO	Piping Plover/Colonial Shorebird Breeding:1986- present	Beach/dune habitat	reports;database	NPS staff	
CACO	Shorebird species survey	Great Beach; Great Island	reports only	Wellfleet audubon Society	
CACO	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; Massachusetts Division of Wildlife	
CACO	Spring Hawk Watch	Pilgrim Heights	Database	Massachusetts Audubon Society; Eastern Massachusetts Hawk Watch	
CACO	Grassland Bird Surveys:199301995 ;2000	Throughout Park	reports and database	Massachuseets Division of Wildlife; Massachusetts Audubon Society	
CACO	Salt Marsh Bird Monitoring:recent past	Ten sites within CACO	Database		
COLO	Breeding Bird Survey:1992- present		database	College of Wm and Mary: Center for Conservation Biology	http://www.mp2- pwrc.usgs.gov/bbs
COLO	Christmas Bird Count: various years most recent 1993-2000	Cape Henry 1944-1945; Yorktown 1948- 1954;Williamsburg 1993- 2000	database	College of Wm and Mary: Center for Conservation Biology	http://www.audubon.org/ bird/cbc
COLO	Heron/Egret Colonies:?-recent past	Throughout Park	database; information included in park reports	Virginia Dept of Game and Inland Fisheries	
COLO	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; Virginia Game and Inland Fisheries	
PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE

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COLO GEWA (George Washington Birthplace National Monument)	Bald Eagle Mid- Winter Surveys	Throughout Park	reports and database	USGS; College of William and Mary
	Bald Eagle Mid Winter Surveys	Throughout Park	reports and database	USGS
GEWA	Bald Eagle Nest Monitoring	Throughout Park	report only	
GEWA	Christmas Bird Count:1936- 1941;1994-2000	Throughout Park	database	http://www.audubon.org/ bird/cbc
GEWA	Breeding Bird Survey	Unknown	Unknown	http://www.mp2- pwrc.usgs.gov/bbs
GEWA	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; Virginia Game and Inland Fisheries
FIIS	Breeding Bird Atlas 1980-1985; ?-2000	Throughout Park	database; report(1980- 1985 data only)	National Audubon Society of New York State http://www.dec.state.ny.u s/website/dfwmr/wildlife/ bba/results/index.cfm
		Atlantic Ocean off FIIS 1940's and 1950's; Captree 1972-2000; FIIS 1963- 1971;Central Suffolk ?-		
FIIS	Christmas Bird count:various years	present	database only	http://www.audubon.org/ bird/cbc
FIIS	Colonial Waterbird Data:		reports, database	http://www.mp2- pwrc.usgs.gov/cwb/
	Neotropical Migrant Mist-netting: 1969- 1972; 1998-2001	Lighthouse Tract	reports	P.A. and F. Buckley/?USGS
FIIS	Neotropical migrant Point Counts, 2001	Federal Wilderness Area	reports; GPS points	NPS staff only
	NYDEC Long Island Colonial Waterbird and Piping Plover Survey	Throughout Park	reports	New York Dept of Environmental Conservation
FIIS	Colonial waterbird populations and colony site trends:mid 1970's	Throughout Park	reports	P.A. and F. Buckley
FIIS	South Shore Estuary Reserve Technical Report:compilation of data 1970-1996	Throughout Park	Various reports and databases	Various researchers and USFWS

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PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE
FIIS	USFWS Waterfowl Surveys of the 1960's	Great South Bay and Moriches Bay	reports only	USFWS; Army Corp of Engineers	
FIIS	Mid-Winter Aerial Survey New York Federated Bird Clubs Winter Waterfowl Ground Surveys:1955-present	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; New York Dept. of Environmental Conservation	
FIIS	Estuarine Restoration Project:1999-present	waterfowl concentration sites	reports and database	Various New York Bird Clubs	
FIIS	Hawk Watch:?-present	William Floyd Estate	reports and databases	USGS/USFWS/Moriches Bay Audubon Society	
FIIS	Hawk Banding Station	Lighthouse	database	Unknown	
FIIS		Lighthouse	database	Theodore Roosevelt Audubon Sanctuary	
GATE	Breeding Bird Atlas 1980-1985; ?-2000 MAPS station (Monitoring Avian Productivity and Survivorship)		database; report(1980-1985 data only) annual data collection, no formal summary, and data entered into collaborator's database	National Audubon Society of New York State	http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/results/index.cfm
GATE	Grassland Restoration Project: 1985-present	Fort Tilden		Institute for Bird Populations	http://www.birdpop.org/maps.htm
GATE	NYDEC Long Island Colonial Waterbird and Piping Plover Survey	Floyd Bennett Field	reports	Various researchers and NPS staff	
GATE	Harbor Herons Project	Throughout Park Swinburne, Hoffman Islands and selected islands in Jamaica Bay	reports	New York Dept of Environmental Conservation	
GATE	Colonial waterbird populations and colony site trends:mid 1970's		reports	New York City Audubon Society	
GATE	Colonial waterbird populations and colony site trends:mid 1970's	Throughout Park	reports	P.A. and F. Buckley	
GATE		Throughout Park	reports	National Audubon Society of New York State	

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PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE
GATE	Fall Shorebird Migrants:1981-1985	Jamaica Bay	reports only		
	Fall Shorebird Migrants:1970's and 1980's	Unknown	database only	Manomet Center for Conservation Sciences	
GATE	Breeding Shorebirds:1985-1988	Sandy Hook	unknown		
GATE	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; New York Dept. of Environmental Conservation	
	New York Federated Bird Clubs Winter Waterfowl Ground Surveys:1955-present	waterfowl concentration sites	reports and database	Various New York Bird Clubs	
GATE	National Wildlife Refuge Data	Jamaica Bay	database	USFWS	
	Avian Use Patterns of Shorebirds, Waterbirds, Common Terns and Waterfowl:1978-1983	Jamaica Bay	reports	Rutgers University	
GATE	Fall Hawk banding Station:1978-1987	Breezy Point	database		
GATE	Fall Hawk Watch:1990-1995	Fort Tilden	database		
GATE	Spring Hawk Watch:1979-1994; 1999-present	Sandy Hook	database	Cape May Bird Observatory;USFWS; New Jersey Audubon Society	
SAHI	Breeding Bird Atlas 1980-1985; ?-2000	Throughout Park	database; report(1980-1985 data only)	National Audubon Society of New York State	
SAHI	Colonial waterbird populations and colony site trends:mid 1970's	Throughout Park	reports	P.A. and F. Buckley	
SAHI	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; New York Dept. of Environmental Conservation	
	New York Federated Bird Clubs Winter Waterfowl Ground Surveys:1955-present	waterfowl concentration sites	reports and database	Various New York Bird Clubs	

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PARK	PROGRAM	LOCATION IN PARK	TYPE OF DATA	PARTNERSHIP	WEBSITE
THST	Breeding Bird Atlas(BBA)		database only	Maryland Ornithological Society	
THST	Mid-Winter Aerial Survey	waterfowl concentration sites	reports and database	Patuxent Wildlife Research Center; MD Dept of Natural Resources	

Table A- 4. Locations for each CBC conducted in or near each Coastal and Barrier Network Park

PARK	Location	Year(s) Conducted	Latitude	Longitude	Circle ID
CACO	Provincetown-Wellfleet	1917; 1950-1953	42	-70.9667	420007007
CACO	Truro	1996-2000	41.9167	-70.0833	MATR
FIIS	LI-Atlantic Ocean off FIIS	1944; 1954; 1956; 1959	40.5	-73.25	403007315
FIIS	LI-Atlantic Ocean off FIIS	1952; 1975	40.5667	-73.1333	403407308
FIIS	FIIS	1963-1971	40.6667	-73.2667	404007316
FIIS	Captree	1972-2000	40.7	-73.25	NYCA
GATE	Rockaway Beach	1904-1909	40.5833	-73.8333	403507350
GATE	Battery: Staten Island	1909-1912	40.6	-74.1	403607406
GATE	Far Rockaway	1911-1914	40.6	-73.75	403607345
GATE	Jamaica	1916	40.6833	-73.8	404107348
GATE	Staten Island	1911-2000	40.5833	-74.15	NYSI
GATE	NY Bay-Sandy Hook	1915	40.6333	-73.9833	403807359
GATE	Sandy Hook	1918-1919; 1976-2000	40.4667	-74	NJSH
SAHI	Cold Spring	1927-1932	41.4167	-73.95	412507357
SAHI	No. Nassau County	1954-2000	40.8667	-73.4333	NYNN
ASIS	Southeastern Worcester County	1947-1948	38.1667	-75.3	381007518
ASIS	Chincoteague NWR	1935; 1946; 1953-2000	37.9667	-75.3667	VACI
THST	Port Tobacco	1928-1966	38.4667	-76.9833	382807659
THST	Port Tobacco	1959; 1979-2000	38.4833	-77.0333	MDPT
GEWA	Washington's Birthplace	1936-1941 1994-2000	38.1167	-76.95	VAWB
COLO	Cape Henry	1944-1945	36.9333	-76.0167	365607601
COLO	Yorktown	1948-1954	37.2333	-76.5167	371407631
COLO	Williamsburg	1947; 1978-1992; 1993-2000	37.2833	-76.7	VAWI

Table A-5. Recent GATE and FIIS Sites surveyed during NYDEC's LI Colonial Waterbird and Piping Plover Surveys

(Species surveyed 1995 and 1998 long-legged waterbirds/ 1994-1999 Piping Plovers, Black Skimmers)

Site	Park	Spp. Found
Carnasie Pol	GATE	CAEG; GREG; SNEG; BCNH; LBHE; TRHE; YCNH; GLIB; GBGU; HEGU; AMOY;
Yellow Bar Hassock	GATE	
Ruffle Bar	GATE	CAEG; GREG; SNEG; BCNH; GLIB; GBGU; HEGU; AMOY;
East High Meadow	GATE	AMOY; COTE;
Jo Co Marsh	GATE	LAGU; AMOY; COTE; FOTE;
Subway Island	GATE	GBGU; HEGU;
Duck Pt. Marsh	GATE	GBGU; HEGU; AMOY;
Little Egg Marsh	GATE	GBGU; HEGU; AMOY; COTE;
Silver Hole Marsh	GATE	LAGU; AMOY; COTE;
Far Rockaway	GATE	PIPL;
Jacob Riis Beach	GATE	PIPL;
Rockaway Beach	GATE	PIPL;
Ft. Tilden Beach	GATE	
Averne by the Sea		PIPL; LETE;
Breezy Point	GATE	GBGU; HEGU; AMOY; PIPL; BLSK; COTE; LETE; ROTE
Hoffman Island	GATE	CAEG; GREG; SNEG; BCNH; TRHE; GLIB; GBGU; HEGU;
Swinburne Island	GATE	GBGU; HEGU;
East Fire Island	FIIS	COTE;
West Fire Island	FIIS	AMOY;
Fire Island Lighthouse	FIIS	COTE;
FIIS Villages	FIIS	LETE;
FIIS Wilderness	FIIS	PIPL; LETE;
FIIS Wilderness Watch Hill	FIIS	GREG; SNEG; GBGU; AMOY;
FIIS Wilderness Long Cove	FIIS	COTE;
Mt. Misery Point ?FIIS		PIPL;
Wading R. Beach ?FIIS		PIPL;
FIIS Pines	FIIS	PIPL; LETE;
FIIS Sunken Forest		PIPL; COTE; LETE;
Pelican Island		GREG;
Hospital Island	FIIS	GBGU
John Boyle Island	FIIS	GBGU; HEGU; AMOY; BLSK; LETE;

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Carter's Island	FIIS	LAGU; AMOY; BLSK; COTE; LETE;
New Made Island		AMOY; BLSK; COTE;
FIIS East aka Smith Point		AMOY; PIPL; COTE; LETE;
East Inlet Island	FIIS	
West Inlet Island (western end)	FIIS	GREG;SNEG;GLIB; GBGU; HEGU; AMOY; BLSK; COTE;
Pattersquash Island	FIIS	COTE;

Species AOU codes:

CAEG=cattle egret

GREG=great egret

SNEG=Snowy egret

BCNH=Black-crowned Night Heron

YCNH= Yellow-crowned Night Heron

LBHE=Little Blue Heron

TRHE=Tricolored Heron

GLIB=Glossy Ibis

GBGU=Great Black-backed Gull

HEGU=Herring Gull

LAGU=Laughing Gull

AMOY=American Oystercatcher

PIPL=Piping Plover

BLSK=Black Skimmer

COTE=Common Tern

FOTE=Forster's Tern

LETE=Least Tern

ROTE=Roseate Tern

Table A-6. Occurrence of Shorebirds at National Wildlife Refuges Within the South Shore Estuary Reserve

Species	Lido Beach	Seatuck	Wertheim
semipalmated plover	sSA	SSA	SSA
Killdeer	sSAB	SSAB	SSAB
lesser golden-plover	SA	SA	SA
black-bellied plover	sSAW	SSAW	SSAW
American oystercatcher	sSAW	SSA	SSAW
spotted sandpiper	sSA	SSA	SSAB
ruddy turnstone	sSA	SSA	SSA
upland sandpiper		SSA	SSA
sanderling	sSAW	SSA	SSA
Dunlin	sSAW	SSAW	SSAW
red knot	sSA	SSA	SSA
stilt sandpiper	sSA	SSA	SSA
white-rumped sandpiper	sSA	SA	SA
western sandpiper	sSA	SA	SA
pectoral sandpiper	sSA	SSA	SSA
least sandpiper	sSA	SSA	SSA
semipalmated sandpiper	sSA	SSA	SSA
spotted sandpiper	sSA	SSA	SSAB
Willet	sSAB	SSAB	SSAB
common snipe	sAW	SAW	SSAW
short-billed dowitcher	sSA	SSA	SSA
Hudsonian godwit	sSA		SSA
Whimbrel	sSA		SSA
American woodcock	sAW	SAW	SSAWB
solitary sandpiper	sSA	SSA	SSA
lesser yellowlegs	sSA	SSA	SSA
greater yellowlegs	sSAW	SSAW	SSAW
northern phalarope	sSA		SSA
red phalarope	sSA		SSA
Wilson's phalarope	sSA		SSA
upland sandpiper		SSA	SSA

Spring (S), Summer (S), Autumn (A), and Winter (W); (B) Indicates the Species is Known to Breed on the Refuge.

Table A-7. Peak Shorebird Counts and Dates at the East and West Ponds of the Jamaica Bay Wildlife Refuge Organized Chronologically by Peak Date

Species	Peak Count	Peak Count Date
least sandpiper	315	18-Jul
short-billed dowitcher	2210	20-Jul
Whimbrel	10	21-Jul
red knot	1685	31-Jul
upland sandpiper	2	2-Aug
semipalmated sandpiper	2834	3-Aug
spotted sandpiper	9	3-Aug
sanderling	310	6-Aug
lesser yellowlegs	177	8-Aug
stilt sandpiper	92	10-Aug
American oystercatcher	140	12-Aug
ruddy turnstone	412	17-Aug
Willet	46	17-Aug
semipalmated plover	1203	18-Aug
American woodcock	12	18-Aug
Western sandpiper	24	26-Aug
white-rumped sandpiper	128	29-Aug
black-bellied plover	1159	4-Sep
greater yellowlegs	519	6-Sep
lesser golden-plover	21	11-Sep
Hudsonian godwit	8	16-Sep
Baird's sandpiper	2	27-Sep
Pectoral sandpiper	72	28-Sep
Killdeer	53	29-Sep
American avocet	3	4-Oct
Dunlin	4379	25-Oct
Marbled godwit	4	various
common snipe	1	various

Table A-8. Rare Species on FIIS

NY Natural Heritage Program (October 01, 2001)

SCIENTIFIC NAME	COMMON NAME	STATE LIST	FED. LIST	HERITAGE RANKS	EO RANK	LAST SEEN
*Location: CARTERS ISLAND						
RYNCHOPS NIGER	Black skimmer	P	SC	G5	S2 F	1997
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B F	1995
STERNA HIRUNDO	Common tern	T		G5	S3B A	1999
*Location: FIRE ISLAND PINES						
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B D	1999
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B D	1999
*Location: FIRE ISLAND SUNKEN FOREST						
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B F	1995
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B D	1999
STERNA HIRUNDO	Common tern	T		G5	S3B D	1999
*Location: FIRE ISLAND VILLAGES						
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B F	1995
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B F	1995
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B D	1998
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B D	1997
STERNA HIRUNDO	Common tern	T		G5	S3B C	1998
FUEGINUS						
*Location: FIRE ISLAND WILDERNESS						
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B C	1998
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B F	1995
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B D	1998
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B C	1998
*Location: FIRE ISLAND WILDERNESS LONG COVE						
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B F	1996
STERNA HIRUNDO	Common tern	T		G5	S3B B	1997
*Location: FIRE ISLAND WILDERNESS WATCH HILL						
ARDEA ALBA	Great egret	P		G5	S2 D	1998
EGRETTA THULA	Snowy egret	P		G5	S2S3 D	1998
CHARADRIUS MELODUS	Piping plover	E	(LE,	G3	S3B F	1993
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B B	1999
STERNA HIRUNDO	Common tern	T		G5	S3B D	1998
*Location: JOHN BOYLE ISLAND						
RYNCHOPS NIGER	Black skimmer	P	SC	G5	S2 F	1996

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STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B	F	1996
*Location: NEW MADE ISLAND							
RYNCHOPS NIGER	Black skimmer	P	SC	G5	S2	E	1997
*Location: PATTERSQUASH ISLAND							
STERNA HIRUNDO	Common tern	T		G5	S3B	E	1997
*Location: RIDGE ISLAND							
RYNCHOPS NIGER	Black skimmer	P	SC	G5	S2	D	1997
STERNA HIRUNDO	Common tern	T		G5	S3B	C	1998
STERNA DOUGALLII	Roseate tern	E	(PS:	G4	S1B		
*Location: SEXTON ISLAND							
ARDEA ALBA	Great egret	P		G5	S2	F	1985
EGRETTA THULA	Snowy egret	P		G5	S2S3	F	1985
RYNCHOPS NIGER	Black skimmer	P	SC	G5	S2	F	1996
STERNA ANTILLARUM	Least tern	T	(PS)	G4	S3B	F	1996
STERNA HIRUNDO	Common tern	T		G5	S3B	B	1999

Table A-9. Rare Species on GATE

NY Natural Heritage Program (October 01, 2001)

SCIENTIFIC NAME	COMMON NAME	STATE LIST	FED. LIST	HERITAGE RANKS	EO RANK & LAST SEEN
*Location: BREEZY POINT					
CHARADRIUS MELODUS	Piping plover	E	(LE, G3	S3B A	1999
RYNCHOPS NIGER	Black skimmer	P	SC G5	S2 B	1998
STERNA ANTILLARUM	Least tern	T	(PS) G4	S3B A	1999
STERNA DOUGALLII	Roseate tern	E	(PS: G4	S1B D	1998
STERNA HIRUNDO	Common tern	T	G5	S3B A	1998
*Location: DUCK CREEK MARSH					
STERNA HIRUNDO	Common tern	T	G5	S3B D	1986
*Location: EAST HIGH MEADOW					
STERNA HIRUNDO	Common tern	T	G5	S3B D	1986
*Location: FLOYD BENNETT FIELD					
ASIO FLAMMEUS	Short-eared owl	E	G5	S2 E	1982
CIRCUS CYANEUS	Northern harrier	T	G5	S3B,S3 C	1990
TYTO ALBA	Barn owl	P	G5	S3 E	1981
*Location: FORT TILDEN BEACH					
CHARADRIUS MELODUS	Piping plover	E	(LE, G3	S3B F	1991
*Location: HOFFMAN ISLAND					
ARDEA ALBA	Great egret	P	G5	S2 D	1998
BUBULCUS IBIS	Cattle egret	P	G5	S2 E	1998
EGRETTA THULA	Snowy egret	P	G5	S2S3 D	1998
EGRETTA TRICOLOR	Tricolored heron	P	G5	S2 D	1995
PLEGADIS FALCINELLUS	Glossy ibis	P	G5	S2 D	1998
*Location: JACOB RIIS BEACH					
CHARADRIUS MELODUS	Piping plover	E	(LE, G3	S3B C	1998
*Location: JAMAICA BAY					
TYTO ALBA	Barn owl	P	G5	S3 E	1984
*Location: JAMAICA BAY EAST					
LARUS ATRICILLA	Laughing gull	P	G5	S1 A	1998
*Location: JO CO MARSH					
STERNA FORSTERI	Forster's tern	P	G5	S1 C	1998
STERNA HIRUNDO	Common tern	T	G5	S3B A	1996
*Location: MARINE PARKWAY BRIDGE					
FALCO PEREGRINUS	Peregrine falcon	E	G4	S3B,SZ E	1998

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*Location: OLD INLET MARSH

KINOSTERNON SUBRUBRUM	Eastern mud turtle	E	G5	S1	E	1988
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*Location: RUFFLE BAR

ASIO FLAMMEUS	Short-eared owl	E	G5	S2	H	1975
ARDEA ALBA	Great egret	P	G5	S2	D	1998
BUBULCUS IBIS	Cattle egret	P	G5	S2	D	1995
EGRETTA THULA	Snowy egret	P	G5	S2S3	D	1998
PLEGADIS FALCINELLUS	Glossy ibis	P	G5	S2	D	1998
GULL NESTING COLONY	Gull nesting colony	U		S?	C	1998

*Location: SILVER HOLE MARSH

STERNA HIRUNDO	Common tern	T	G5	S3B	B	1996
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*Location: SUBWAY ISLAND

RYNCHOPS NIGER	Black skimmer	P SC	G5	S2	D	1986
STERNA HIRUNDO	Common tern	T	G5	S3B	D	1986

Table A-10. BBS Coordinators by State

State & State Code ()		Coordinator Name	Agency	Contact #'s
MD (46)	THST (02)	Keith Pardieck	USGS Patuxent Wildlife Research Center 12100 Beech Forest Rd. Laurel, MD 20708-4038	301-497-5843 Keith_Pardieck@usgs.gov
MA (47)	CACO (901)	Wayne Petersen	Massachusetts Audubon Society 208 South Great Road Lincoln, MA 01773	781-259-9500 wpetersen@massaudubon.org
NY (61)	FIIS (004)	Charles Smith	Dept. Natural Res., Fernow Hall Cornell University Ithaca, NY 14853	607-255-3219 crs6@cornell.edu
VA (88)	COLO (913) ASIS (916)	Rick Reynolds	Dept. of Game & Inland Fisheries P.O. Box 996 Verona, VA 24482	540-248-9386 RReynolds@dgif.state.va.us

ASIS (BBS is located within Chincoteague NWR)

THST (the La Plata BBS Route is located nearby THST)

CACO (BBS is located within CACO)

FIIS (the Jones Beach BBS is located 14 miles west of FIIS along the same barrier beach chain)

COLO (BBS is located within COLO)

Table A-11. State Departments of Fish and Wildlife

State	Department	Location	Contact #'s
New York	New York Department of Environmental Conservation (NYDEC)	Headquarters: Loop Rd. Bldg. 40 Stony Brook, NY 11790-2356 Counties: Nassau and Suffolk (FIIS and SAHI)	General:(631) 444-0354
New York	New York Department of Environmental Conservation (NYDEC)	Headquarters: 1 Hunters Pt. Plaza, 4740 21st Street Long Island City, NY 11101-5407 Counties: Bronx, Kings, New York, Queens and Richmond (GATE)	General: (718) 482-4900 Wildlife: (718) 482-4922 Fisheries: (718) 482-4922
New Jersey			
Virginia	Virginia Game and Inland Fisheries		
Massachusetts	Massachusetts Division of ??Wildlife		
Maryland	Maryland Department of Natural Resources		

Table A-12. Acronyms Used in Chapter II. Avian Monitoring Program Review

Acronym	Name of Program
BBA	State Breeding Bird Atlas
BBC	Breeding Bird Census
BBS	North American Breeding Bird Survey
CBC	Christmas Bird Count
ISS	International Shorebird Survey
MAPS	Monitoring Avian Productivity and Survivorship
MWAS	Mid-Winter Aerial Survey
NABCI	North American Bird Conservation Initiative
NAWCP	North American Waterbird Conservation Plan
NAWMP	North American Waterfowl Management Plan
NWR	National Wildlife Refuge
PIF	Partners In Flight

APPENDIX B

Table B-1. Faunal Inventories of COLO

<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>Jamestown Island</i>	<i>Past</i>	U.S. Department of the Interior, National Park Service, Colonial National Historical Park. No Date. Flora and fauna of Jamestown Island and vicinity, as first observed by the settlers.
<i>Throughout Park</i>	<i>1991</i>	Virginia Division of Game and Inland Fisheries, Giles, Robert H. 1991. Biota of Virginia, animals of Colonial National Historical Park, 08-08-91.
<i>Unknown</i>	<i>1991</i>	Clampitt, Christopher A. 1991. A natural areas inventory of the lower peninsula of Virginia: City of Williamsburg, James City County, York County. Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, Natural Heritage Technical Report 92-1, Richmond, Virginia.
<i>Green spring Unit</i>	<i>1998, ?1999</i>	Bradshaw, Dana. 1998. Faunal Survey of the NPS Green Spring Unit Colonial National Historical Park. Center for Conservation Biology, College of William and Mary, Williamsburg, VA.
<i>Cheatham and Wormley Pond Drainages</i>	<i>1998</i>	Hobson, Christopher S. 1998. A Natural Heritage Inventory of the Cheatham and Wormley Pond Drainages, Colonial National Historical Park. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Natural Heritage Technical Report 98-11, Richmond, VA.
<i>Grafton Pond Sinkhole Complex</i>	<i>1998</i>	No Author. 1998. No Title. Pages ? in Roble, S.M. A Zoological Inventory of the Grafton Ponds Sinkhole Complex, York County, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.
<i>Sinkholes in Park</i>	<i>1999</i>	No Author. 1999. No Title. Pages ? in Virginia Department of Conservation and Recreation, Division of Natural Heritage. A Biological Survey of the Coastal Plain Depression Ponds (Sinkholes) of Colonial National Historical Park, Yorktown, VA. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.
<i>Jamestown Island</i>	<i>2002</i>	Chazal, A.C. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Van Alstine, N.E. Virginia Department of Conservation and Recreation, Division of Natural Heritage. 2002. Plants and Animals Recorded from the Jamestown Island 400 Project Area, Colonial National Historical Park. Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, 02-01, Richmond, Virginia.
<i>Jamestown Island</i>	<i>2002</i>	Weber, J.T., Coulling, P.P. 2002. Ecological Communities of the Jamestown Island 400 Anniversary Planning Project Area, Colonial National Historical Park. Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, 02-07, Richmond, Virginia.

Table B-2. Inventories of Rare, Threatened and Endangered Species at COLO

<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>Throughout Park</i>	<i>Unknown</i>	Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage. No Date. List of rare, threatened, and endangered species list for Colonial National Historical Park (James City and York Counties). Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.
<i>Cheatham Annex</i>	<i>1990</i>	Author unknown? (no author included in original record). 1990. An inventory of rare, threatened, and endangered species of the NSC, Cheatham Annex, York County, VA. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Natural Heritage Technical Report 90-4, Richmond, Virginia.
<i>Throughout Park</i>	<i>1991</i>	Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage. 1991. Special status animal species in and near Colonial National Historical Park and Cheatham Annex inventory lists. Pages ? in No Author. Draft general management plan, environmental assessment. National Park Service, Yorktown, VA.
<i>Throughout Park</i>	<i>1990</i>	Clampitt, Christopher. 1990. Untitled: Preliminary maps of locations for rare, threatened, and endangered (RT&E) species within Colonial National Historical Park. Commonwealth of Virginia, Division of Natural Heritage, Richmond, VA.
<i>Throughout Park</i>	<i>1994</i>	Bradshaw, D. 1994. Sensitive species locations and status, Colonial National Historical Park. Department of Game and Inland Fisheries, Richmond, VA.
<i>Throughout Park</i>	<i>1995</i>	Belden, Allen, Stevenson, Dirk, Roble, Steven M. 1995. Inventory of rare, threatened and endangered plant and animal species at Colonial National Historical Park, Yorktown Creek drainage. Virginia Department of Conservation and Recreation, Natural Heritage Technical Report #95-5, Richmond, VA.
<i>Throughout Park</i>	<i>1993,95</i>	No Author. 1995. Rare, threatened, and endangered species and critical habitats, natural heritage conservation and planning, Colonial NHP and environs. 17" x 24". National Park Service, Yorktown, VA.
<i>Throughout Park</i>	<i>1996</i>	Vanasse Hangen Brustlin, Inc. 1996. Threatened and endangered species survey : Colonial National Historical Park, York County, Virginia. National Park Service, Yorktown, VA.
<i>Jamestown Island</i>	<i>2001</i>	Chazal, A.C., Van Alstine, N.E. 2001. An Inventory for Rare, Threatened, and Endangered Species in the Jamestown Island 400 Project Area, Colonial National Historical Park. Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, 01-23, Richmond, Virginia.

Table B-3. Faunal Inventories of FIIS

Location in Park	Year(s)	Status	Bibliography
Throughout Park	1963	U	Murphy, R.C. 1963. Geology, flora, and fauna of Fire Island barrier beach. Pages ? in No Editor/Author. Proceedings of the Symposium on the Fire Island Barrier Reef and Great South Bay Area. Suffolk College, Adelphi University, Oakdale, NY.
Unknown	1963	U	Snyder, D.P. 1963. A report on natural history reconnaissance of Fire Island and adjacent barrier beaches. Unpublished, U.S. Department of Interior, National Park Service, Denver Service Center, Denver, CO.
Watch Hill	1971	U	U.S. Department of Interior, National Park Service, Fire Island National Seashore. 1971. Flora and fauna of the Watch Hill area. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, New York.
Throughout Park	1972	U	Jack McCormick & Associates. 1972. Fire Island National Seashore, Suffolk County, New York: Preliminary Assessment of Environmental Resources as an Input to a Conceptual Master Plan. Jack McCormick & Associates, Prepared for the National Park Service, Devon, PA. Kumar, Nares, Sanders, John E. 1970. No Title. Geol. Soc. Amer., Abstr. 2 1: 27.
Throughout Park and WFE	1975	U	McCormick, Jack, and Associates, Inc. 1975. Environmental Inventory of Fire Island National Seashore and the William Floyd Estate, Suffolk County, New York. U.S. Department of Interior, National Park Service, Denver Service Center, Denver, CO. 461 pp.
Throughout Park	1980	U	U.S. Department of Interior, Fish and Wildlife Service. 1980. Environmental Inventory for the Fire Island Inlet to Montauk Point, New York: Beach Erosion Control and Hurricane Protection Project Reformulation Study. Unpublished, U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. 58 pp.
Throughout Park	1987	U	Northup, James G. 1987. A Final Report on the Ecological Inventory Project Fire Island National Seashore. Boston, MA.
WFE	1999	U	Lynch, Patrick, Ebert, James A. 1999. Ecological Inventory, William Floyd Estate Fire Island National Seashore. pages (Unpublished).

Table B-4. Ecological Inventories at FIIS

Location in Park	Year(s)	Bibliography
Fire Island barrier beach	1963	Murphy, R.C. 1963. Geology, flora, and fauna of Fire Island barrier beach. Pages ? in No Editor/Author. Proceedings of the Symposium on the Fire Island Barrier Reef and Great South Bay Area. Suffolk College, Adelphi University, Oakdale, NY.
Watch Hill	1971	U.S. Department of Interior, National Park Service, Fire Island National Seashore. 1971. Flora and fauna of the Watch Hill area. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, New York.
Throughout Park	1971	McCormick, Jack, and Associates, Inc. 1971. Natural Resources Inventory of Fire Island National Seashore. Unpublished, U.S. Department of Interior, National Park Service, Denver Service Center, Denver, CO.
Throughout Park	1972	Rozsa, R. 1972. Checklist to the invertebrates, fish, amphibians, reptiles, and mammals of the Fire Island National Seashore. U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 4 pp.
Throughout Park	1975	McCormick, Jack, and Associates, Inc. 1975. Environmental Inventory of Fire Island National Seashore and the William Floyd Estate, Suffolk County, New York. U.S. Department of Interior, National Park Service, Denver Service Center, Denver, CO. 461 pp.
Fire Island Inlet to Montauk Point	1978	U.S. Department of Interior, Fish and Wildlife Service. 1980. Environmental Inventory for the Fire Island Inlet to Montauk Point, New York: Beach Erosion Control and Hurricane Protection Project Reformulation Study. Unpublished, U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. 58 pp.
Fire Island Inlet to Montauk Point	1983	Hanlon, J.R. 1983. Fish and wildlife resource studies for the Fire Island Inlet to Montauk Point, New York, Beach Erosion Control and Hurricane Protection Project Reformulation Study: Estuarine Resource Component. U.S. Department of Interior, Fish and Wildlife Service, Region 5, Long Island Sub-Office, Upton, NY. 44 pp. + appendices.
Fire Island Inlet to Montauk Point	1983	U.S. Department of Interior, Fish and Wildlife Service. 1983. Fish and Wildlife Resource Studies for the Fire Island Inlet to Montauk Point, New York: Beach Erosion Control and Hurricane Protection Project Reformulation Study: Terrestrial Resource Component. U.S. Department of Interior, Fish and Wildlife Service, Region 5, New York Field Office, Cortland, NY. 140 pp.
William Floyd Estate	1984	Sayre, M.W. 1984. Wildlife habitat considerations related to old field succession on the William Floyd Estate. Appendix I of Clark (1984) Report. Unpublished, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA. 9 pp.
Unknown	1987	Northup, James G. 1987. A Final Report on the Ecological Inventory Project Fire Island National Seashore. Boston, MA.
William Floyd Estate		Lynch, Patrick, Ebert, James A. 1999. Ecological Inventory, William Floyd Estate Fire Island National Seashore. pages (Unpublished).

Chapter III. Amphibians and Reptiles

Section I. Introduction

Herpetofauna is the term that encompasses all amphibians (frogs, salamanders, newts and caecilians) and reptiles (snakes, lizards, turtles, crocodilians, and tuataras). Although two different vertebrate classes (Amphibia and Reptilia) are included, many species of both groups occupy the same habitats throughout the world and are faced with the same environmental perils. Sometimes the shorter word *herp* is used instead of *Herpetofauna*, but the meaning is the same: amphibians and reptiles.

Amphibian populations are in decline in many areas of the world. In cities and the countryside, in rainforests and wetlands, countless areas which previously hosted a range of healthy amphibian populations now have fewer frogs, toads, and salamanders. Scientists conducting field research have produced compelling evidence for habitat loss, climate change, UV radiation, contaminants and pollutants, disease, and predation by invasive species as possible causes. Amphibian declines are not necessarily occurring in "likely" places where human impacts are obvious, such as cities and suburbs prone to development and pollution. Some of the most noted and dramatic declines are happening in "protected" areas such as national parks.

The scientific community now suspects that there is no one reason for worldwide declines of amphibians. For example, diseases or pollutants that have decimated a species in one part of the world may be completely absent in another region that has also experienced a mysterious die-off of its amphibians. In some cases, die-offs can be attributed to a specific cause; in others, the cause is not so obvious. Many researchers believe that multiple, additive causes - for instance, a high incidence of UV radiation combined with the presence of a disease - may be at the heart of large numbers of worldwide declines.

Section II. Conservation Plans

In 1998 an international meeting of experts convened by the National Science Foundation concluded that significant amphibian declines have occurred in protected areas not subjected to obvious changes in habitat, such as National Parks, National Wildlife Refuges, and wilderness areas. Based on the information presented at these and other similar meetings, scientists concluded that the numbers and geographic extent of the reports indicated that the situation should be approached as a potential environmental crisis.

In 2000, the President of the United States and the Congress directed the Department of the Interior (DOI) agencies to develop a plan to initiate monitoring of trends in amphibian populations on DOI lands and conduct research into causes of declines. The DOI has stewardship responsibilities over vast land holdings in the United States, much of which is occupied by or is potential habitat for amphibians. The U.S. Geological Survey (USGS), the science and research bureau for DOI, was given lead responsibility for planning and organizing this program, named

the Amphibian Research and Monitoring Initiative or ARMI, in cooperation with the National Park Service, Fish and Wildlife Service, and Bureau of Land Management.

ARMI has the following objectives:

- Initiate long-term monitoring to determine trends in amphibian populations
- Conduct research into causes of amphibian declines and malformations
- Make use of relevant expertise within USGS and DOI
- Make the information available to cooperators, land managers, the scientific community, and the general public

Studies by USGS scientists will concentrate on DOI and other federal lands, but ARMI will provide the framework for incorporating data collected on non-federal lands to encourage participation by states, universities, and non-governmental organizations. The framework can be conceptualized as a pyramid with extensive and necessarily coarse measurements at many monitoring sites across the country (the base of the pyramid), mid-level efforts at a moderate number of sites to provide a regional perspective on the status of amphibians (the middle portions of the pyramid), and intensive research efforts at a relatively small number of index sites throughout the country (the top of the pyramid).

Activities at the different levels of the framework are integrated by common databases and reporting; comparable protocols, analytical tools, training, and planning; research on causes of change, which at all levels is guided by monitoring results; synthesis across ecological regions, scientific disciplines, and governmental and institutional boundaries and modeling.

ARMI monitoring activities will be organized nationally among seven regions, involving several USGS science centers, herpetologists, and hydrologists. The extensive bottom tier of the pyramid will provide an opportunity for participation and synthesis of data collected on non-federal lands by a variety of programs (the North American Amphibian Monitoring Program, state National Heritage Programs, etc.), state governments, universities, and non-governmental organizations. More intensive monitoring will emphasize DOI lands (National Parks, National Wildlife Refuges, BLM lands) and will be coordinated by USGS scientists.

Research will occur at all levels of the hierarchical framework and will focus on two tasks: identifying causes for declines/malformations, and refining and developing new methods for monitoring. Studies will focus on a broad range of environmental stressors and contaminants as well as the interaction of biotic and abiotic factors that may affect declining amphibian populations. Specific hypotheses and research designs will be guided by the results of monitoring activities, and will include both field and laboratory investigations.

The USGS Patuxent Wildlife Research Center will develop and manage a centralized database for data collected under ARMI, including timely electronic transfer of information to cooperators, land managers, the scientific community and the interested public. It is hoped that this database will provide a forum for other researchers to share their findings, so that analyses can address trends in species throughout their distributions, not just on federal lands.

A permanent ARMI Steering Committee with representation from within and outside the federal government will provide oversight and regular review of all ARMI activities. This committee

will help to ensure that ARMI is progressing satisfactorily toward achieving its stated goals and objectives, and that its products are timely, relevant, and useful in meeting the needs of land managers, scientists, and other stakeholders interested in the conservation of amphibian resources.

Other DOI agencies have resources to work on priority ARMI activities. The Fish and Wildlife Service has initiated a nationwide survey on 48 National Wildlife Refuges in 31 states for contaminants that may be inducing malformations in amphibians. The National Park Service is working with USGS to conduct amphibian inventories in National Parks. Initial efforts are focused in parks that are part of PRIMENet (Parks Research and Intensive Monitoring of Ecosystems Network), a group of large parks with intensive air quality and UV radiation monitoring. The Coastal Network falls within the ARMI Northeast Region. At CACO, work on salamander egg masses is currently being conducted by USGS.

The North American Amphibian Monitoring Program (NAAMP) is a collaborative effort among regional partners, such as state natural resource agencies and nonprofit organizations, and the U.S. Geological Survey (USGS) to monitor populations of vocal amphibians. The USGS provides central coordination and database management. The regional partners recruit and train volunteer observers to collect amphibian population data, following the protocol of the NAAMP.

Section III. State Atlases

VA Atlas of Amphibians and Reptiles

The Virginia Atlas of Amphibians and Reptiles is the first of its kind in fifteen years. It is a source of distribution information about amphibians and reptiles in Virginia for survey and inventory, monitoring, conservation and management, and education purposes. The information on which this atlas is based was derived from two primary sources. Most of the localities illustrated on the maps are supported by a voucher specimen in a museum collection. Most of these were examined by Joseph Mitchell to verify their identification. The second source of locality information is the scientific collection permit reports submitted annually to the Virginia Department of Game and Inland Fisheries (DGIF). These records were accepted if they occurred within the range of a species defined by museum records. Outlying permit records were included only if they were backed up with a specimen that had been donated to a museum and verified. Unvouchered literature records are not included in this atlas. Thus, the distribution records depicted on each range map illustrate records that can be verified in two ways, by voucher museum specimens or report documentation. All locality coordinates are maintained by DGIF.

New York State Amphibian and Reptile Atlas Project

New York State has a diverse and widespread herpetofauna. Species representation includes most species present in New England and several additional species from adjacent northern, southern and western regions. The Amphibian & Reptile Project (Herp Atlas) was a ten-year survey that

was designed to document the geographic distribution of New York State's herpetofauna to monitor changes in populations and to make sound management decisions.

The survey began in 1990 and continued through the end of 1999. The NY State Herpetological Atlas Project is a cooperative venture that systematically collects data on all species of herpetofauna statewide. Data collection emphasizes standard atlas techniques to record occurrences of species on a latitude and longitude grid pattern, with each grid cell equivalent to a USGS 7.5' quadrangle. Each grid cell is referred to as an atlas block. Project volunteers throughout New York include professional biologists, naturalists, educators, and other contributors. Professionals validate all records of species occurrence. Data management and retrieval and display uses FoxPro, MapInfo, Access and ArcInfo. To date, about 840 volunteers have contributed over 21,000 species observations to the Atlas database. Thirty-two species of amphibians and 35 species of reptiles, including three introduced species, have been reported. Five marine sea turtles found off coastal Long Island are omitted from this dataset. At least one species of herpetofauna has been reported in 849 of the 985 atlas blocks, (86%) of the state, and at least ten species are known from 340 of the blocks (34%). Records prior to 1989 were compiled and comprise an historic database. The unit of measurement for collecting atlas data was the USGS 7.5 minute topographic quadrangle. Contact: NYS Herp Atlas Project N.Y.S.D.E.C.; 625 Broadway; Albany, NY 12233-4754

The New York Endangered Species Unit has collaborated extensively with the Cooperative Research Unit in the NY Gap Analysis effort and has provided approximately 21,000 reported individual observations of reptiles and amphibians for use in completion of the Gap effort.

In 1993, the New York Cooperative Fish and Wildlife Research Unit began research aimed at identifying areas of the state that were rich in vertebrate species and that heretofore were either unrecognized and/or unprotected by legal statutes. This research project has developed in concert with efforts in other states into a national Gap Analysis Program, which in essence seeks to characterize and link vegetative habitat as determined from Thematic Mapper (TM) satellite imagery to all of the extant vertebrate life in North America. Using geographic information system (GIS) techniques, areas of high species richness can be evaluated as to their size, disjunct nature, and degree of legal protection afforded by current statute and land ownership.

Sixty-four species of amphibians and reptiles can be found living wild in New York, not including marine turtles, established exotics, and important subspecies/hybrid complexes. With the exception of the Plymouth Redbelly Turtle, known only from eastern Massachusetts and Rhode Island, New York has all of the herpetofauna species found in New England.

In general, a large number of species are rather uniformly distributed across the entire state. These include the Spotted Salamander, Redback Salamander, Northern Two-lined Salamander, Red Spotted Newt, Bullfrog, Northern Gray Treefrog, Northern Spring Peeper, Green Frog, Wood Frog, Pickerel Frog, Common Snapping Turtle, Painted Turtle, Common Garter Snake, Northern Water Snake, and Eastern Milk Snake. The American Toad is also found throughout the state, except on Long Island.

Section IV. Status of Amphibian and Reptiles by Park

ASIS

Table 3-1. *Herp Inventories of ASIS*

Herp Group(s)	Location in Park	Year(s)	Bibliography
All	Throughout Park	1972	Lee, David S. 1972. List of the amphibians and reptiles of Assateague Island. Pages 90-95 in No Author. Bulletin of the Maryland Herpetological Society.
All	Unknown	1990	Conant, Roger, Mitchell, Joseph C., Pague, Christopher A. 1990. Herpetofauna of the Virginia barrier islands. Pages 364-380 in Martin, James H. Biota of the Virginia Barrier Islands. Virginia Academy of Science, Richmond, VA.
All	Throughout Park	1990	Schwaner, Terry. 1990. Reptile and Amphibian Survey.
Fowler's Toad	Chincoteague	1989	Hranitz, J.M., Hill, F.C., Sagar, R.G., Klinger, T.S. 1989. Abundance, size, and sex ratios of bufo woodhousei fowleri hinckley (chordata: amphibia) on Assateague Island, Virginia, and the adjacent mainland. Pages 169a in No Author. American Zool.
Fowler's Toad	Chincoteague	1990	Hranitz, John M., Hill, Frederick C., Sagar, Robert G., Klinger, Thomas S. 1990. The status of bufo woodhousei fowleri hinckley (chordata: amphibia) on Assateague Island, Virginia and the adjacent mainland. Pages 98-99 in No Author. Journal of the Mississippi Academy of Sciences.
Marine Turtles	Throughout Park	1990-2001	Occurrence records of marine turtles collected by ASIS resource management staff as part of marine animal stranding and salvage monitoring program, 1990-2001
All	Throughout Park	1993	Mitchell, Joseph C., J.M. Anderson, and T.D. Schwaner. 1993. The Amphibians and Reptiles of Assateague Island National Seashore. Final Report to National Park Service. Assateague Island National Seashore. Berlin, MD.
All	Throughout Park	1994	Mitchell, Joseph C., Anderson, John M. 1994. Amphibians and reptiles of Assateague and Chincoteague Islands. Virginia Museum of Natural History, Martinsville, VA.

Species-Habitat Relationships

The known amphibian fauna of Assateague and Chincoteague islands consists of six frogs and one salamander (Table ?) Mitchell notes Fowler's toads are commonly found in all habitats on the islands, except perhaps on the open beach adjacent to the Atlantic Ocean and in the marshes. They were the most commonly encountered amphibians on the island during his 1990-1992 study. Lee (1972) found them to be the most common specie on the island, occurring most abundantly in the secondary dunes and shrub thickets. The species has been found to be more significantly abundant on the Virginia portion of Assateague Island than on the nearby mainland (Hrantiz et al,1993). Lee (1972) noted that Green frogs were common throughout Assateague Island wherever adequate low salinity water could be found. Mitchell (1994) recorded this species in several vegetative communities, including disturbed areas around human habitation and in buildings. This species was observed from April through October. The New Jersey

Chorus frog (*Pseudacris triseriata kalmi*) occurs only in New Jersey and on the Delmarva Peninsula (Conant and Collins, 1991). It has been observed only in the Chincoteague National Wildlife Refuge at the southern end of Assateague Island near the lighthouse (Lee, 1973b and unpublished notes in the library of Roger Conant). This species is widespread in all but western North America (Conant and Collins, 1991). Chorus frogs are seldom seen except during the breeding season when they occupy forested habitats (Mitchell, 1994). Temporary pools created by winter precipitation with grass cover appear to be preferred breeding sites (Mitchell, 1994). Lee (1973b) found them in freshwater ponds; however this population may now be extinct (Mitchell, 1994). Check to see if now it is considered a full species (*Pseudacris kalmi*)-may now be the least known of all chorus frogs. Bullfrogs *Rana catesbeiana* may have been introduced to Assateague Island. The only known location for this species on the islands is based on a collection of tadpoles in Chincoteague NWR (Conant et al., 1990). However, more recently the impoundments dried up, which subsequently killed the tadpoles (Mitchell, 1994). Mitchell (1994) recommended continued monitoring of this species. Green frogs *Rana clamitans melanota* are distributed from Nova Scotia south to central Florida and west to eastern Texas and Oklahoma (Conant and Collins, 1991). They have been found in two locations on the southern end of Assateague Island (Harris, 1975; Conant et al., 1990). Mitchell (1994) notes this species may be more widespread than current information suggests and observations on this species are needed. Southern Leopard frog *Rana sphenoccephala* was first recorded on Assateague Island in Assateague State Park and Chincoteague NWR by Lee (1972). They have since been found at a number of other locations throughout the island and on all paved roads and parking lots (Mitchell, 1994). This species has also been documented for Chincoteague Island (Conant et al., 1990). They can be found in most habitats except for perhaps the open beach and lower marsh (Mitchell, 1994). Lee (1972) found them in the natural, water-filled depressions.

The red-backed salamander *Plethodon cinereus* is distributed from the Maritime Provinces in northeast Canada southwestward to upper Minnesota and south to Kentucky, Virginia and parts of North Carolina (Conant and Collins, 1991). It occurs on Chincoteague Island but is unknown from Assateague Island (Conant et al., 1990). They occupy forested habitats, including pine forests on barrier islands.

Mitchell (1994) notes the confirmed presence of this species on Chincoteague Island suggests that it either once occurred on Assateague and became extirpated or has yet to be reported from this island. He further notes humans burn the forest on Assateague regularly and the resulting conditions may be less suitable. In addition, Assateague Island is more exposed to storms that cause overwash. Alternatively, this species could have been transplanted to Chincoteague by humans in shipments of logs or soil in nursery stock. However, Assateague Island still contains adequate forested habitat and this species should be sought initially in the southern portion.

Mitchell (1994) notes the reptiles on Assateague and Chincoteague islands occur in a wide variety of habitats, from the dry dunes to the ocean to the estuarine marshes. The island's reptilian fauna consists of three species of sea turtles, one estuarine turtle, and six predominantly freshwater turtles including box turtles, one lizard and seven species of snakes. The sea turtles are seasonal visitors and may be found in the ocean or estuary, or on occasion washed up on the beach (see Marine Turtles below). All other species are permanent residents.

Snapping turtles *Chelydra serpentina* are the largest of the freshwater turtles on Assateague Island. The species occurs in North America from Nova Scotia southward through Texas and into Mexico and Central America. It occurs throughout Maryland (Harris, 1975) and Virginia (Mithcell, 1994). Snapping turtles inhabit freshwater ponds, impoundments, tidal creeks and marshes on Assateague Island (Mitchell, 1994). Snapping turtles are harvested by humans for food. Lee (1972) reported that Chincoteague NWR had them removed "because of their possible detrimental effect on nesting waterfowl". Mitchell (1994) notes that snapping turtles may occasionally take waterfowl in the water, but they do not usually feed out of the water, their danger to waterfowl when on their nests or when asleep ashore is nonexistent.

Eastern Painted Turtles *Chrysemys picta picta* distribution includes from Nova Scotia to the Carolinas and southwestward to Louisiana (Conant and Collins, 1991). They are widely distributed in Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Lee (1972) reported this species was a common inhabitant of freshwater impoundments in Chincoteague NWR, where it was reportedly introduced by a local naturalist. They inhabit freshwater ponds on Assateague Island. They may be seen basking on logs, stumps, grass clumps and the edges of banks. Mitchell (1994) found one in ASIS in May 1992. Mitchell (1994) reports little is known of the population ecology of this species on barrier islands including information on clutch size, nest location, rates of predation, survivorship of adults and hatchlings and population size. He recommends obtaining information on the introduction into Chincoteague NWR to establish their origin and to determine the rate of dispersal northward.

Spotted Turtles *Clemmys guttata* occur widely in the states bordering the Atlantic Ocean northward to Nova Scotia (Conant and Collins, 1991). They are widely distributed in Maryland (Harris, 1975) and Virginia (Mitchell, 1994). One individual was observed in Chincoteague NR in spring 1971 (Lee, 1972). One was located on ASIS in May 1972. They are conspicuous inhabitants of freshwater ponds and ditches. They prefer shallow water with abundant vegetation. This species has been placed on the protected list in some states due to loss of freshwater wetland habitat and over collection for the pet trade. Mitchell (1994) noted almost nothing is known of the ecology of this species on barrier islands.

Northern Diamondback Terrapins *Malaclemys terrapin terrapin* are distributed in coastal waters south to the Gulf of Mexico. The northern subspecies (*Malaclemys terrapin terrapin*) ranges from Cape Hatteras to Cape Cod. This species is the only true estuarine turtle in the world. It has a 9-21 parts per thousand salinity preference (Dunson and Mazzotti, 1989). It is adapted behaviorally and physiologically to the salt marsh environment. Diamondback terrapins eat snails (*Littorina*, *Melampus*, *Nassarius*), fiddler crabs, marine annelids and occasionally salt marsh plants.

Presently the abundance of the diamondback terrapin has rebounded from its depleted state caused earlier this century by over harvesting as a delicacy food. Interest in this species as a food item though, has again increased, especially in some ethnic food markets of cities such as new York (McDougal 1997) Garber (1988) also noted that large numbers were being taken from New Jersey, Delaware, Maryland and Virginia for food markets.

Mitchell, 1994 notes threats to the diamondback terrapins include humans who take the adults for food or drown them in crab pots. Wading birds, crows and mammals such as raccoons eat hatchlings. Mortality is high in nests. Raccoons, muskrats, foxes and shrews eat eggs.

Mitchell, 1994 notes another major cause of mortality is crab pots, especially those set by recreational users. He notes that the opening that allows crabs to enter the chamber also allows all but the largest diamondback terrapins to enter the trap. Many turtles drown because they need to reach air to breathe and the pots are set under water. Crab pots are often left submerged during high tides when the probability of drowning is the highest. This cause of mortality has contributed to the decline of diamondback terrapins in many areas along the coast of North America. The openings of crab pots can be modified to reduce the turtle's ability to enter it and at the same time enhance the catch of crabs. Crabbing is a major recreational activity in Virginia and Maryland.

Females and hatchlings are found on many parts of Assateague Island (Mitchell, 1994). Recognized habitats include the freshwater marsh community, salt marsh community, and pond community. Adults are occasionally found on the ocean side of Assateague Island and on the beach.

Red-bellied turtles *Pseudemys rubriventris* have a relatively limited range in North America. It is found from New Jersey south through northeastern North Carolina with a disjunct population located in Massachusetts (Conant and Collins, 1991). Lee (1972) first reported it from freshwater impoundments at the southern end of Assateague Island. It is believed that humans may have introduced it to this area. Red-bellied turtles inhabit freshwater ponds and impoundments. Mitchell (1994) notes that additional survey work is needed on this species on Assateague Island in order to determine if the species still exists there. Red-bellied turtles should be considered a rare inhabitant until proven differently.

Eastern box turtle *Terrapene carolina carolina* is found throughout the eastern half of North America (Conant and Collins, 1991). Lee (1973) first reported this species for Assateague Island. Mitchell (1994) found it in several locations in 1990-1992. Box turtles are terrestrial and found in pine and hardwood forests, wax myrtle thickets and on secondary dunes. They occasionally enter water during hot weather. They are active from about April through October. They overwinter in loose soil, under clumps of vegetation, or stumps. Numerous natural populations of box turtles have declined due to human take for pets and due to habitat loss (Mitchell, 1994).

Eastern Mud Turtle *Kinosternon subrubrum subrubrum* historically occurred from Long Island, New York southward through Florida and westward into Central Texas (Conant and Collins, 1991). It is widely distributed in Maryland (Harris, 1975) and Virginia (Mitchell, 1994) and occurs on many barrier islands (Conant et al., 1990). Lee (1972) reported mud turtles from the northern and southern ends of Assateague Island. Mitchell (1994) found it in several locations. Mud turtles inhabit freshwater ponds and impoundments but may be found in brackish pools and marshes (Mitchell 1994). They often spend large periods of time on land, being active following rain events. Mitchell (1994) notes additional observations would allow for accurate determination of distribution across habitats.

Northern fence lizard *Sceloporus undulatus hyacinthinus* are distributed widely across the eastern half of North America south of southern New York and about midway across Pennsylvania westward to eastern Nebraska (Conant and Collins, 1991). This species is found throughout Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Lee (1972) reported sighting to females at the lighthouse at Chincoteague NWR on 18 August 1972. None have been found on either of the islands since then. Mitchell (1994) notes this species needs to be confirmed on Assateague Island.

Northern Black Racer *Coluber constrictor constrictors* Black racers are widely distributed in eastern North America, barely reaching into Canada (Conant and Collins, 1991). They occur widely in Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Lee (1972) reported them to be common throughout Assateague Island. Mitchell (1994) recorded several observations with snakes active between early March and late October. Black racers inhabit open grassy and woodland areas; however, they occur in most terrestrial habitats. Mitchell (1994) notes this is probably the most abundant snake on Assateague Island. Additional records are needed to document its complete distribution.

Black Rat Snake *Elaphe obsoleta obsoleta* are found throughout eastern North America above the Deep South into extreme southern Canada (Conant and Collins, 1991). They are widely distributed in Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Lee (1972) reported the first observation of this species in Chincoteague NWR. Mitchell (1994) found this snake the Maryland portion of Assateague Island. They inhabit hardwood forests and scrub zones on Assateague Island.

Eastern hognose snake *Heterodon platirhinos* has been found to be common on Assateague Island (Lee, 1972). They are commonly encountered in the secondary dune community, but may be found on primary dunes and even in the surf on the beach (Lee, 1972). Scott (1986) found them to be the most abundant in the secondary community whereas few were found in shrub and grassland communities and none were seen in the salt marsh habitat. Mitchell (1994) found them to be active from April through October.

Northern water snake *Nerodia sipedon sipedon* is found throughout Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Lee (1972) first reported this snake from Chincoteague NWR, but found it to be uncommon. They inhabit freshwater and brackish ponds, pools and impoundments. They may occasionally be seen in marshes. Mitchell (1994) notes this species seems to have undergone a population decline on Assateague Island during recent drought periods when the impoundments dried up. He notes site-specific data are needed to better ascertain its distribution and habitat affinities on Assateague Island.

Rough Green snake *Opheodrys aestivus* occur on virtually every barrier island along the Delmarva Peninsula (Conant et al., 1990). Lee (1972) reported observing one individual from the North Beach area (bayside) of Assateague Island in the fall of 1972. They usually inhabit shrubs and low trees. They have been found under boards and piles of debris in the wrack zone on islands further south of Assateague Island (Mitchell, 1994). This snake preys on

invertebrates, such as spiders, harvestmen, caterpillars, crickets and grasshoppers. Mitchell (1994) notes that biologists believe this snake population has declined in parts of its range because of pesticides taken up by its prey and passed up the food chain.

Northern Brown Snake *Storeria dekayi dekayi* is widely distributed over the eastern half of North America (Conant and Collins, 1991). The northern race is found from Maine south to central North Carolina. It occurs throughout Maryland (Harris, 1975) and Virginia (Mitchell, 1994). Mitchell found *Soreria dekayi* for the first time on Assateague Island in 1992. It is a completely terrestrial snake, occasionally found under boards, logs and stumps. Northern brown snakes inhabit shrub succession and woodland communities on Assateague. Mitchell 1994 found this snake in May and August. They feed primarily on earthworms and slugs on Assateague (Mitchell, 1994). The biology of this snake is little known on barrier island ecosystems.

Occurrence records of marine turtles collected by ASIS resource management staff as part of marine animal stranding and salvage monitoring program, 1990-2001

CACO

Table3-2. Herp Inventories at CACO

Herp Group	Location in Park	Year(s)	Bibliography
Diamondback Terrapin	Unknown	1926	Babcock, H. 1926. The diamond-back terrapin in Massachusetts. Copeia. 1926 150: 101-104.
Marine Turtles	Unknown	1965	Bleakney, J.S. 1965. Reports of marine turtles from New England and Canadian waters. Canadian Field Naturalist. 79 2: 120-128.
All	Unknown	1974	Lazell, J.D. =Jr. 1974. List of reptiles and amphibians found on Cape Cod with their location. American Museum of Natural History, New York, NY.
All	Unknown	1974	Lazell, J.D. =Jr. 1974. Reptiles and Amphibians in Massachusetts. Massachusetts Audubon Society, Lincoln, MA.
All	Unknown	1992,93	No Date. Massachusetts Herp Atlas Program database. MAS. 1992-93, Lincoln, MA.
All	Throughout Park	1992	Jones, L. Kyle. 1992. Cape Cod National Seashore Reptile and Amphibian Survey. Cape Cod National Seashore, CACO Natural Resources Report 92-04, South Wellfleet, MA 02663.
All	Throughout Park	1999	Colburn, E.A. 1999. Inventory and Monitoring of Amphibians of the Cape Cod National Seashore: A Preliminary Report to the U.S. National Park Service. pages (Unpublished).
All	Throughout Park	2001	Cook, R.P. 2001. Amphibians and Reptiles at Cape Cod National Seashore. pages (Unpublished).

Species-Habitat Relationships

There are 24 species of amphibians and reptiles that are nonmigratory at CACO (Table ?). Five species of Migratory marine turtles have been noted that forage in the offshore waters of CACO. The northernmost known population of diamondback terrapin occurs in the marshes along the periphery of Wellfleet Harbor. While this subspecies can be found from Cape Hatteras to Cape Cod, Wellfleet marks its absolute northern limit, subject to severe climatic variations as well as the steady advance of human activity into its once secluded salt marsh habitat. Observing an animal at the extreme edge of its range serves as an important bellwether to monitor the health of

the ecosystem. Massachusetts lists the diamondback terrapin as a threatened species and recognizing its signal role within the harbor environment, Massachusetts Audubon's Wellfleet Bay Wildlife Sanctuary has organized research studies of terrapins since 1980 with informal observations stretching back a quarter century. Females have been noted to nest among the dunes and open habitats adjacent to the marsh often within CACO. In 2001, research efforts by the Wellfleet Bay Wildlife Sanctuary were extended to include Great Island within CACO boundaries.

Recent events affecting the terrapin habitat have injected urgency into current research. Preliminary observations suggest a marked decrease over the last decade in nesting activity at the once prime location within Wellfleet Harbor, as well as a deterioration of salt marsh and tidal flat habitat from potentially dangerous debris. The year ended with an unprecedented die-off of terrapins, from two-year-old juveniles to ancient nesting females. Proposals are pending to expand aquaculture activity on tidal flats adjacent to key terrapin nesting and nursery habitat. Housing development ringing formerly secluded salt marshes continues unabated, and seawalls still are being erected along nesting dunes. Gravid turtles, forced to settle for less suitable nests on dirt roads or to migrate to upland sites, are killed by vehicles in record numbers. Taken as a whole, these pressures on the diamondback terrapin and its habitat may pose a substantial risk to its survival in Wellfleet Harbor.

The eastern spadefoot toad (threatened) has been found throughout CACO, particularly in Provincelands. CACO appears to be one of the most important sites for spadefoots in Massachusetts. Spotted turtles (special concern) appear to be widespread in CACO, but not very numerous. They have been found in a number of different shallow, aquatic habitats, but little is really known about their habitat use in CACO. Some are known to hibernate on land, and migrate to wetlands in the spring. The four-toed salamander (special concern) is another species whose distribution and abundance at CACO is largely unknown. It is a terrestrial species that breeds in sphagnaceous bogs and swamps and is difficult to find. It has only been recorded at CACO a handful of times over the past 20 years. The eastern box turtle (special concern) is a species that is reported to be in decline throughout much of its range in the eastern United States. Losses of habitat, road kill, and pet collection have all taken a toll on its numbers. Dr. Robert Cook reports that road kills seem to be infrequent at CACO and the eastern box turtle still appears to be fairly common at CACO.

In addition, the eastern hognose snake is a species special in a number of ways. It feeds most exclusively on toads, with a pig-like nose adapted to burrowing after toads in loose, sandy habitats. Though the toads are still common, and there is plenty of sand, the hognose snake appears to have declined at CACO. However, this is just speculation. Also, the northern water snake, an inhabitant of swamps, marshes and pond margins feeds on fish and frogs. Although, there appears to be an abundance of food and appropriate habitat, there are very few observations of this species.

Table ? summarizes the current (2000) state of knowledge regarding the occurrence and distribution of amphibians and reptiles at CACO . It is based primarily on the observations of Irene Seipt, Kyle Jones, John Portnoy, Brett Still, Bob Prescott, Betsy Colburn, Joan Milam and Jackie Sones in the 1980's and 1990's.

A protocol amphibian monitoring program for CACO is scheduled to begin soon. This work is being conducted by Peter Paton (University of Rhode Island) and Robert Cook (NPS). In addition, salamander egg mass work is currently being conducted by the USGS

COLO

Table 3-3. Herp Inventories of COLO

Herp Group	Location in Park	Year(s)	Bibliography
All	Unknown	1999	Mitchell, Joseph, C., Reay, Karen, K. 1999. Atlas of Amphibians and Reptiles in Virginia. Virginia Department of Game and Inland Fisheries, Richmond, VA.
Cooperhead Snakes	Unknown	2000	Wright, Robert, A., Gray, Warren, P. 2000. Copperheads on the York-James Peninsula, Virginia. Catesbeiana. 20 1: 23-31.

*Also refer to Faunal and R,T,E Inventories for COLO

Currently, Dr. Joe Mitchell is conducting a reptile and amphibian study of the Jamestown Environs with a report due in 2002.

GEWA

Table 3-4. Herp Inventories of GEWA

Herp Group	Location in Park	Year(s)	Bibliography
Unknown	Throughout Park	1970	Author unknown. 1970. Survey of vertebrates, George Washington Birthplace National Monument. National Park Service, Washington's Birthplace, VA.
All	Throughout Park	1986-1989	Eckerlin, Ralph P. 1991. The herpetofauna of George Washington Birthplace National Monument, Virginia. Catesbeiana. 11 1: 11-17.
Turtles	Unknown	1995	Ernst, Carl H. 1995. Untitled: Turtle trapping at George Washington Birthplace National Monument. George Mason University, Department of Biology, Fairfax, VA.

Species-Habitat Relationships

A three-year survey of the amphibians and reptiles of the George Washington Birthplace National Monument, Westmoreland County, Virginia was conducted from March 1986-April 1989. (Eckerlin 1991) Twelve amphibian and 18 reptile species were observed (Refer to Appendix ?, Table 1). New locality records for Westmoreland County include: *Ambystoma opacum*, *Hyla crucifer*, *Hyla cinerea*, *Hyla chrysoscelis*, *Rana catesbeiana*, *Rana utricularia*, *Kinosternon subrubrum*, *Chrysemys picta*, *Pseudemys rubriventris*, *Scincella lateralis*, *Eumeces inexpectatus*, *Nerodia sipedon*, *Thamnophis sauritus*, *Opheodrys aestivus*, and *Lampropeltis getula*.

Most specimens were captured, identified, and released. A few species were photographed and released. Some salamander larvae were taken back to the laboratory to be keyed, and were fixed in formalin and preserved in alcohol. Salamander larvae and some reptiles found dead are in the collections of George Mason University. Identifications were based on field characters as given in Conant (1975).

Sampling began in March 1986 and continued at irregular intervals through April 1989. Observations were made during 11 months of the year; no sampling was done in December. During this period, sampling was conducted for a total of 24 days with one to as many as 13 observers. Approximately 480 man hours were spent in the field.

A list of all reptiles and amphibians encountered at GEWA is presented in Table 1. Thirty species of amphibians and reptiles were observed. The most commonly encountered amphibians were the bullfrog, green frog, and southern leopard frog, each of which was observed virtually every month from March through October. Salamanders were rarely encountered. Among 12 species expected only 3 (25%) were collected. By contrast, of 14 frogs and toads expected 9 (64%) were observed. In all, 12 amphibian species were verified.

The most commonly observed reptiles were the common snapping turtle, eastern box turtle, red-bellied turtle, eastern painted turtle, and the black rat snake, all of which were observed during 4 or more months. Most of the other species were seen only sporadically. Six of 10 turtle species expected (60%) were observed. Five of 6 lizard species expected (82%) were observed. Snakes were the least successfully collected; 7 of 20 species expected (35%) were observed. Many snakes are fossorial, others are nocturnally active, and most require optimum temperature and humidity conditions to come to the surface and become active. For these reasons an adequate snake survey is difficult to perform. In all, 18 species of reptiles were encountered.

The diamondback terrapin, *Malaclemys terrapin*, was only observed from a shell. No living terrapins were seen. Although it is possible that tides may have carried the shell to the observation site I believe that this is a good record. The tidal marsh habitat was available and another record of the species exists for Westmoreland County (Tobey, 1985).

No copperheads, *Agkistrodon contortrix*, were seen on the GWBNM site but two were collected as roadkill specimens within 2 km of the property. Anecdotal accounts of copperhead sightings were relayed by two of the Park Service employees.

Among amphibians, streamside salamanders were noticeably absent because no stream with rocks for cover exists on the property. The frog, *Rana sylvatica*, was also conspicuously absent. In fact, no records of the wood frog are known for the Northern Neck (Tobey, 1985; Martof et al., 1980). Whether this is real or an artifact of inadequate collecting is unknown.

The amphibian and reptile populations on the GEWA property appeared to be healthy in terms of individual appearance and stable in terms of population size. Diversity was remarkably high, especially in view of the fact that this site has been disturbed by the agricultural activity of man

since the late 1600's. No specific management program was recommended regarding amphibians and reptiles. Additional collecting will undoubtedly add additional species to the list of those known to occur here.

Herp Monitoring Programs at GEWA

Currently, there are no herp NPS monitoring programs occurring at GEWA (pers. communication Rijk Morawe, GEWA Resource Manager)

THST

No Herp Inventories are known to exist for Thomas Stone Historic Site. Currently, there are no herp NPS monitoring programs occurring at GEWA (pers. communication Rijk Morawe, THST Resource Manager)

FIIS

Table 3-5. Herp Inventories of FIIS

Herp Group	Location in Park	Year(s)	Bibliography
Land Turtles	Unknown	1962	Smith, J.D. 1962. Land turtles on Fire Island. Long Island Forum. 25(1):9: 21-22.
All Freshwater Species	Throughout Park	1995,96	Caldecutt, W.J. 1997. Freshwater wetlands delineation and inventory of wetland herpetological species on Fire Island National Seashore. pages (Unpublished).

Species-Habitat Relationships

William Caldecutt from the State University of New York in Stony Brook conducted an inventory of freshwater wetland herpetological species in the summers of 1995 and 1996.

Caldecutt (1997) noted that only eight species reptiles and amphibians were found on FIIS (Appendix 4, Table 1) compared to the dozens of herpetological species found on Long Island (Conant and Collins, 1991). He notes FIIS lacks most of the aquatic turtles, all but two snakes, all frogs, all salamanders and all but one toad in comparison to Long Island. Data from his study was entered into NPSpecies.

In his study, he identified seventy-three distinct freshwater sites in eight separate regions of FIIS. Individual herpetological specimens were identified at these sites specific locations and corresponding latitude/longitude coordinates noted. Multiple sites within a fresh water area were either visually inspected or dip nets were used depending upon water clarity, turtles were surveyed and captured when possible for identification. Snakes, semi-terrestrial turtles and adult toads were noted when observed, but not actively sought due to a lack of rocks, logs and other hiding places.

Five reptile and amphibian species were found to some degree dependent on freshwater. The Fowler's toad was the only amphibian species found on FIIS. Adult toads were commonly found in all habitats, both upland and wetland with approximately equal frequency. Fowler's toads breed in freshwater in spring. Larvae were found in the large pond near the Visitor's Center and

a low area on Burma Road in the Wilderness Area. Larvae were also found in several slightly brackish wetlands.

One juvenile Northern Black Racer snake was found in the Wilderness Area. It was noted that no overall association seems to exist between this species and freshwater wetlands. Eastern Garter snakes were found in freshwater sites adjacent to the Lighthouse Visitor Center.

Two adult female spotted turtles and a male plastron were found in the wetlands of Watch Hill. Eastern mud turtles were found in several brackish wetlands on FIIS. One mud turtle was found near the Wilderness Area. Common snapping turtles are highly aquatic and inhabit brackish wetlands and saltmarshes on FIIS. At least three were observed in a freshwater pond in the Fire Island Pine wetland. Eastern box turtles were found in two freshwater wetlands (one adult male in each) of the Sunken Forest and the tract between Seabay Beach and Saltaire. A box turtle was also found in the freshwater wetland of Watch Hill by one of Caldecutt's colleagues in 1996. This species is likely to occur in other areas with similar habitats, but it is difficult to observe due to its elusive nature.

In addition, two adult female diamondback terrapins were found in upland communities near Old Inlet and the remains of juvenile terrapins were found adjacent to several fox dens. Data were not recorded for this brackish water species.

In New York State, the diamondback terrapin is listed as a species of special concern. New York state historic terrapin distribution favored salt marsh and estuarine habitats. Morreale (1992) reports "Recent observations and anecdotal accounts indicate that once again diamondback terrapins are widespread among New York's coastal waters. At present, however, it is unknown whether there are few or many such locations.

The northern diamondback terrapin is a year round resident of Long Island's South Shore Estuary Reserve, which includes FIIS and FIIS-WFE. It is common along the margins of the estuary in marshes and near shore bays. In NY, terrapins are active April to October and hibernate during the winter. Females are encountered on land only during the six-week nesting period that peaks mid-June to mid-July (SSER, 1998).

Currently, NY State lists the eastern mud turtle as an endangered species. The USFWS and NYDEC recommend that the eastern mud turtle (*Kinosternon subrubrum*) is a species that warrants study. One of the four occurrence areas is located at FIIS on the north side of the barrier beach near Whale House Point within the Wilderness Area (USFWS, 1997).

Known Species Status at the William Floyd Estate

Refer to Lynch, P. 1984. Ecological Inventory: William Floyd Estate Fire Island National Seashore. Unpublished report to the National Park Service. Data from this study was entered into NPSpecies. This report lists all amphibians and reptiles found in this abbreviated inventory of the William Floyd Estate.

Herp Monitoring Programs on FIIS

No known long-term monitoring programs for reptiles and amphibians historically or currently exists for FIIS or FIIS-WFE. However, Bill Capitano, a student of Dr. Russell Burke' of Hofstra

University is radio tracking box turtles of Wertheim National Wildlife Refuge (located in close proximity to FIIS-WFE) with the goal of locating nests and tracking the hatchlings. From 1998-1999 an amphibian drift fence study was conducted at FIIS (pers. communication FIIS personnel). When this data is obtained, it will be entered into NPSpecies and the Metadata Catalog.

GATE

Table 3-6. Herp Restoration Projects at GATE

Herp Group	Location in Park	Year(s)	Bibliography
Unknown	JBNWR	1979	Cook, R.P. 1979. The amphibians and reptiles of Jamaica Bay Wildlife Refuge: A proposal for increasing species abundance and diversity. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Jamaica Bay Wildlife Refuge, Brooklyn, NY.
Unknown	Sandy Hook, Ft. Tilden, Breezy Point	1991	Anonymous. 1991. Population status of amphibians and reptiles released at Sandy Hook, Fort Tilden, and Breezy Point Tip, Gateway National Recreation Area, Brooklyn, NY, 1987-1991. Pages ? in No Author. Restore amphibian and reptile community. Project statement sheet. Gateway National Recreation Area, National Park Service.
Unknown	Sandy Hook	1993	Anonymous. 1993. Wildlife restoration at Sandy Hook. Pages ? in No Author. Restore amphibian and reptile community. Project statement sheet. Gateway National Recreation Area, National Park Service.

Table 3-7. Herp Inventories of GATE

Herp Group	Location in Park	Year(s)	Bibliography
Diamondback Terrapins	Unknown	Unknown	Cook, Bob. No Date. A Natural History of the Diamondback Terrapin. No data. 18 1: 25-31.
All	Throughout Park	Unknown	Cook, Robert P. No Date. Preliminary distribution list of the amphibians and reptiles of Gateway National Recreation Area, New York - New Jersey. 6 pp.
Snakes	Unknown	1915	Engelhardt, G.P., Nichols, J.T., Latham, R., Murphy, R.C. 1915. Long Island snakes. Copeia 1915(17).
All	Great Kills Park	1975	U.S. Department of Interior, National Park Service, Gateway National Recreation Area. 1975. List of amphibians and reptiles occurring at Great Kills Park, Gateway National Recreation Area. 4 pp.
Reptiles	Round, Nike, North Ponds	1987	Ettinger, Gail. 1987. Reptile inventory of: Round Pond (Hake's Lake), Nike Pond, North Pond, and immediate areas. ~30 pp.
Eastern Mud Turtle	Sandy Hook	1988	Basmagy-Salesman, Karen. 1988. Current status of the eastern mud turtle (<i>Kinosternon s. subrubrum</i>) on Sandy Hook. U.S. Department of the Interior, National Park Service, Gateway National Recreation Area, Sandy Hook Unit, Sandy Hook Unit?.
Freshwater	Sandy Hook	1989	Cook, Robert P, Dorfman, Don. 1989. Freshwater turtles on Sandy

<i>Turtles</i>			Hook. Underwater Naturalist. 19 1: 24-25.
<i>All</i>	<i>JBNWR</i>	<i>1989</i>	Cook, Robert P., Pinnock, Clive. 1989. Amphibians, reptiles, and mammals of the Jamaica Bay Wildlife Refuge. Gateway National Recreation Area, National Park Service, US Department of the Interior, Brooklyn, NY.
<i>All</i>	<i>Throughout Park</i>	<i>1989</i>	Cook, Robert P. 1989. Amphibians and reptiles. Gateway National Recreation Area, National Park Service, US Department of the Interior, Brooklyn, NY.
<i>Diamondback Terrapin</i>	<i>Unknown</i>	<i>1992</i>	Morreale, Stephen J. 1992. The status and population ecology of the diamondback terrapin, <i>Malaclemys terrapin</i> , in New York. Okeanos Ocean Research Foundation, Inc, Hampton Bays, NY.
<i>Eastern Box turtle, Painted Turtle</i>	<i>Unknown</i>	<i>1996</i>	Cook, Robert P. 1996. Movement and ecology of eastern box and painted turtles repatriated to human-created habitat. The City University of New York, New York, NY.

Herp Monitoring Programs and Research at GATE

At GATE, recent data about diamondback terrapins suggest they are located in a variety of sites within GATE and Jamaica NWR.

Existing herp programs include Reptile/Amphibian Reintroduction and Captive breeding programs conducted by Dr. John Behler of the Wildlife Conservation Society. Focus species include the hognose snake and Fowler's toad. Recently, money has been allocated by NPS I&M program to work on populations of diamondback terrapins at Sandy Hook.

In addition, Dr. Russell Burke and his graduate student have been conducting extensive research since 1998 on the population ecology of diamondback terrapins at GATE. The following are abstracts from each of these projects:

Nesting Ecology of Diamondback Terrapins (*Malaclemys terrapin*) at Gateway National Recreation Area.

The nesting ecology of diamondback terrapins (*Malaclemys terrapin*) was studied in 1998 and 1999 at GATE. Populations of nesting terrapins were found at three different locations. Most of this research was conducted at the Jamaica Bay Wildlife Refuge.

Female terrapins nested from early June through late July, and laid up to two clutches per season, depositing an average of 10.9 eggs per nest. Nesting activity increased with daily high temperature and high tide. The majority of nests were counted in shrub-land, mixed-grassland, and dune habitats, but nest density was highest on a man-made, sandy trail and also on beaches. Hatchling survivorship among nests varied between 22% and 85%.

Raccoons were found to be the primary predator of terrapin nests and adult terrapins. Raccoons were not historically found in the Refuge, but a population appears to have been established within the last 20 years. Raccoons depredated 92.2% of nests monitored during the nesting season. We counted a total of 1,319 and 1,840 depredated nests in 1998 and 1999, respectively, at the Refuge. Only 5.2% of terrapin nests survived to produce hatchlings. The carcasses of 23

adult-female terrapins were found that were apparently killed by raccoons as they come on land to nest.

Comparison of Fertility Rates and Hatchling Survivorship of Field and Laboratory Incubated Nests

Long Island's population of terrapins were severely impacted by exploitation from the mid-1800's through the 1930's. Since then terrapins have made a remarkable recovery but, the development of estuaries has resulted in a substantial habitat loss. Parks such as the GATE are vital nesting sites for these aquatic turtles due to this loss. However, the stability of these populations may be threatened by pollution and nest depredation. For this reason it is important to document the current fertility rates, emergence success and hatchling mortality of the population. To that end, eggs were collected from nests at Ruler's Bar Hassock (part of GATE) and incubated in the laboratory at temperatures ranging from 26o C-34o C. Hatchlings from these eggs will be raised in the laboratory to ascertain hatchling mortality and sex ratios. This data will be compared to data collected from nests that were protected in the field using wire-mesh excluder devices to prevent nest depredation.

Predators and predation rates Jamaica Bay Wildlife Refuge

The Jamaica Bay/Breezy Point Unit (JB/BPU) is one of the four management units of GATE. Ruler's Bar, the largest island of JB/BPU, has been the main area of terrapin studies at GATE so far. A raccoon population appears to be established in Ruler's Bar Hassock since the 1980's and is now destroying 92% of terrapin nests.

I have begun surveying the seven other upland islands within JB/BPU, in an attempt to learn more about important nesting beaches and how predation rates vary between them. The seven islands are: Elder's Point, Pumpkin Patch, Subway Island, Ruffle Bar Canarsie Pol, Little Egg Marsh and the already studied Ruler's Bar Hassock. These islands differ in size, proximity to the mainland, and, very likely, both mammal and bird inhabitants. Comparison of predation rates on the islands to predation occurring in different parts of GATE will occur. In addition, a survey of the birds and mammals of these islands to document potential and actual nest and adult predators will occur.

Limiting Predation on Terrapin Eggs by Using Taste Aversion Training

The size and behavior of the raccoon population at JB NWR will be studied. These raccoons are the major predator of terrapin nests and also eat adult terrapins. Raccoons will be live-trapped, measured, marked, and released. Twelve will be fitted with radio transmitter collars so their movements can be tracked. It is hoped that predation on terrapin eggs will be limited by using taste aversion training, which has worked at some sea turtle nesting beaches.

SAHI

No Herp Inventories are known to exist for Sagamore Hill National Historic Site. However, amphibian and reptile species noted to be present at the Oyster Bay NWR, located across Oyster Bay from SAHI, are listed in Appendix ?, Table 1. Currently, there are no herp monitoring programs occurring at SAHI

Section V. Marine Turtles

All six species of sea turtles in the U.S. are protected under the Endangered Species Act of 1973 (Table 3-8). Through interagency coordination under Section 7 of the ESA, sea turtles are protected by ensuring that Federal actions will not jeopardize the continued existence of the species including dredging activities by the U.S. Army Corps of Engineers, U.S. Navy explosives testing, Environmental Protection Agency designation of dredged material disposal sites, and many other Federal agencies for activities ranging from nuclear power plant construction to scientific research.

Table 3-8. Sea Turtles Protected under the ESA

<u>Common Name</u>	<u>Scientific Name</u>	<u>ESA Status</u>	<u>Critical Habitat</u>
Green turtle	<i>Chelonia mydas</i>	Endangered/Threatened	Designated
Hawksbill turtle	<i>Eretmochelys imbricata</i>	Endangered	Designated
Kemp's ridley turtle	<i>Lepidochelys kempii</i>	Endangered	
Leatherback turtle	<i>Dermochelys coriacea</i>	Endangered	Designated
Loggerhead turtle	<i>Caretta caretta</i>	Threatened	
Olive ridley turtle	<i>Lepidochelys olivacea</i>	Endangered/Threatened	

Recovery plans have been finalized for all of the sea turtles found in US waters. These plans are available for review at http://www.nmfs.noaa.gov/prot_res/PR3/recovery.html.

Section V. 1. Marine Turtle Initiatives

Riverhead Foundation for Marine Research & Preservation

The Riverhead Foundation for Marine Research & Preservation (formally Okeanos Research Foundation) and the New York State Marine Mammal and Sea Turtle Stranding Program have conducted a number of research projects designed to examine the biology and ecology of the marine environment in New York's waters. Accomplishments and discoveries of the NY State Marine Mammal and Sea Turtle Stranding Program and the Riverhead Foundation for Marine Research & Preservation include: Confirmation of at least 25 cetacean (whale and dolphin) species in the NY region and confirmation of near shore sightings of the critically endangered Northern right whale. In addition to tissue and data collection on stranded marine mammals and sea turtles, the Riverhead Foundation is also conducting an extensive marine mammal and sea turtle abundance study throughout the coastal waters of NY State. Biologists from the Riverhead Foundation are conducting aerial, shipboard, and land-based surveys to assess abundance and movements of marine mammals and sea turtles throughout the NY region. Data

will be analyzed to established baseline abundance levels of marine mammals and sea turtles in the NY area. It can then be used by agencies such as National Marine Fisheries Service (NMFS), NY State Department of Environmental Conservation (NYSDEC), and the Riverhead Foundation as a basis for regulatory decisions regarding management parameters, strandings and rehabilitation efforts, and public conservation and education. Preliminary results of surveys have shown that New York is home to hundreds of harbor seals each winter. These seals haul out regularly in several other locations along both the north and south shores. If pertinent data for FIIS is obtained, it will be entered into NPSpecies and the Metadata Catalog. Contact: Riverhead Foundation for Marine Research & Preservation, 428 East Main Street, Riverhead, NY 11901; (631) 369-9840 FAX:(631) 369-9826

Coastal Research and Education Society of Long Island

The Coastal Research and Education Society of Long Island was founded in the summer of 1996 by a group of experts in marine mammal science, environmental sciences, education and conservation. CRESLI was formed for the purposes of conducting research, providing educational experiences and promoting conservation of coastal ecosystems. Research and education are linked in all CRESLI activities. As such, CRESLI actively seeks cooperative alliances with researchers, educational institutions, and the participation of the general public. Many of the cetacean research projects, for example, utilize public whale watch cruises as a platform for collecting data and educating the public at the same time.

Commercial fishermen and pleasure boaters have also been enlisted to provide sighting information used in population and distribution studies, as well as assisting in the rescue of stranded and entrapped animals. This public participation has not only led to the finding that Long Island's coastlines provide a critical habitat for juvenile loggerhead, Kemp's ridley and green sea turtles, but has also fostered greater awareness and appreciation of these animals and their habitats among fishermen, boaters and the public.

CRESLI's long-term monitoring programs regarding the distribution and abundance of sea turtles include 1) **NEW YORK STATE SEA TURTLE PROGRAM:** In cooperation with local fishermen entrapped turtles are recovered for population, distribution and behavioral studies. 2) **ANALYSES OF LONG TERM TRENDS IN CETACEAN, PINNIPED AND SEA TURTLE STRANDINGS** Since the late 1970s comprehensive data on strandings has been kept for this region. In addition historical data has been compiled and examined 3) **TELEMETRIC TRACKING OF MARINE MAMMALS, SEA TURTLES AND SEA BIRDS** Using the latest technology in wildlife tracking, marine mammals and turtles are tracked to examine their foraging and migratory movements in the region and along the Atlantic coast. 4) **TISSUE STUDIES:** Ongoing collection and testing of tissue samples from marine mammals and sea turtles for anthropogenic contaminants. 4) **DNA STUDIES:** Ongoing analysis of population status and movements of sea turtles and marine mammals by means of DNA analysis.

Section V.2. Status of Marine Turtles Species found along Atlantic Coastline

The NY coastal area has one of the highest diversities of sea turtles reported anywhere in the United States. Studies by the Okeanos Foundation have demonstrated that this area is a critical development habitat for the highly endangered Atlantic (Kemp's) ridley turtle, as well as a major feeding area for leatherback, green, and loggerhead sea turtles.

Loggerhead sea turtle (*Carretta carretta*)

The loggerhead sea turtle, listed as threatened in July 1978, is the most abundant sea turtle occurring in U.S. waters. Loggerheads are omnivorous and eat a variety of benthic and pelagic food items, including bivalve mollusks, sponges, gastropods, squids, crabs, shrimp, and a variety of sea grass species.

These turtles once nested throughout the tropics and as far north as Maryland in the US. Although they are still quite numerous, their nesting range has diminished as man has invaded coastal areas for housing and recreation. Several large nesting beaches in Florida and the Carolinas can still be found.

Mitchell, 1994 notes that loggerheads may be found during the late spring and summer season on the Atlantic Ocean side of Assateague Island, as well as occasionally in the bays behind the island. Graham (1973) mentioned that a female nested on the beach in ASIS in 1972. Conant et al. (1990) noted that a head-start program started in 1969 was in operation by the USFWS on ASIS through at least 1972 in order to start a rookery; however, it was unsuccessful.

In the spring and fall, loggerheads are concentrated south of New Jersey in the shelf/slope waters. Loggerheads arrive as early as May. Juvenile loggerheads regularly inhabit Long Island Sound and the eastern bays where they feed mainly on crustaceans and shellfish. Sadove (1993) found that loggerheads and green sea turtles make limited use the South Shore Estuary Reserve area for feeding and juvenile development. Some adults can be found along the ocean shore and in New York Harbor. Their northern winter range is limited to water temperatures above 10°C (50°F).

Loggerheads have been found dead and alive along CACO's beaches and nearby town beaches by the Cape Cod Sea Turtle Stranding Network, which monitors these beaches annually in the fall.

Major threats to loggerhead survival are those that occur throughout the marine environment: collisions with vessels and damage from their propellers; entanglement at sea with ropes, nets (including shrimp nets and pound nets), and cables deployed in a variety of activities; ingestion of marine debris, especially plastic bags, plastic and styrofoam pieces, tar balls, and balloons; and commercial fisheries interactions. In addition, egg collecting, raccoon predation on nests and eggs, and a wide variety of human activities directly threaten loggerheads or indirectly alter or destroy their habitat.

Green sea turtle (*Chelonia mydas*)

In 1978, under the Endangered Species Act of 1973, the Atlantic green sea turtle was listed as threatened, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. The green turtle is also listed on Appendix I of CITES.

Only one record for this species exists for the vicinity of Assateague Island (Mitchell, 1994). A female was noted in the Chincoteague Bay at White Rock, Worcester County, Maryland (Schwartz, 1960).

Along the New York coastline, green sea turtle distribution is related to submerged aquatic vegetation such as *Ulva* and *Codium* spp. located in warm, shallow bays. They also feed on crabs, crustaceans and submerged aquatic vegetation such as eelgrass. They are found in the New York Bight from June through October. Sadove (1993) found that green sea turtles make limited use the South Shore Estuary Reserve area for feeding and juvenile development. Adult green turtles have been observed in the New York Bight; however, there is a wide range in the size of individuals, suggesting that there is not a clearly defined age class migration into the area. It is estimated that at least 100 individuals use the region each year for foraging.

Green Sea turtles have been commonly found dead and alive along CACO's beaches and nearby town beaches by the Cape Cod Sea Turtle Stranding Network that monitors these beaches annually in the fall.

Threats to this species survival include oil and gas exploration, development and transportation, dredging, marina and dock development, pollution, seagrass bed degradation, fisheries activities such as trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries, collisions with boats, power plant entrapment, underwater explosions, offshore artificial lighting, entanglement, ingestion of marine debris, poaching, predation, diseases and parasites and threats to the southern nesting habitats.

Leatherback sea turtle (*Dermochelys coriacea*)

The leatherback sea turtle is considered endangered throughout its global range. It was listed as endangered under the authority of the Endangered Species Act in 1970 and was included in Appendix I of CITES, ratified by the U.S. in 1974. Leatherbacks are water column feeders, feeding predominantly on a variety of soft-bodied invertebrates such as pelagic medusae (jellyfish), siphonophores, and salpae in the temperate and boreal latitudes. Although they are found in coastal waters, leatherbacks are pelagic creatures of the open ocean capable of diving to great depths. Leatherbacks engage in lengthy migrations from their foraging to nesting areas, presumably to optimize both opportunities. They are able to maintain their core (deep) body temperature considerably higher than their surroundings. This extraordinary ability explains why leatherbacks can range as far north as Newfoundland, Greenland and Iceland where the sea temperature, even in the summer, is only in the 30 - 40 degree range.

Several records exist for the leatherback in the Chesapeake Bay (Harris, 1975), and the Virginia Institute of Marine Science has a record for Assateague Island (Conant et al., 1990).

Live turtle capture locations were mapped using data provided by Okeanos Ocean Research Foundation. Not much live sea turtle activity in the Great South Bay or Moriches Bay was reported. However, in recent years, leatherback turtle strandings have been common on the south-facing Atlantic ocean Beaches. Leatherbacks sea turtles are one of the most abundant turtles in the FIIS area from May to November, but are found in near shore ocean waters and rarely in the estuary. They are commonly seen in the New York Bight from May through November. Adult and large juveniles are both found feeding in the nearcoastal areas, but rarely in the bays or lagoons. Rough estimates indicate that 500 to 800 animals use the Bight each year.

Worldwide population estimates indicate a decline in numbers of leatherbacks between 1980 and 1995. This decline is attributed to a number of factors including loss of nesting habitats, destruction of nests by poachers, ingestion of marine debris, propeller wounds and interactions with commercial fishing operations. In particular, they commonly ingest plastics floating on the surface, which resemble the jellyfish they catch for food.

Currently, CRESLI is actively involved in studying and protecting Leatherbacks in NY's coastal waters and on nesting beaches in Costa Rica and Isla Culebra.

Hawksbill sea turtle (*Eretmochelys imbricata*)

The hawksbill sea turtle was listed as endangered under the Endangered Species Act in 1970 and listed under CITES in 1974. Hawksbill sea turtles are found throughout the Caribbean, Bahamas, Florida Keys, and southwestern Gulf of Mexico. They are not reported frequently in shallow coastal systems exhibiting high turbidity and soft bottoms, such as the eastern U.S. coast north of Cape Canaveral, Florida. There are few records to indicate that this species is anything but a rare or anomalous visitor to the New York Bight area. Illegal slaughter of hawksbills for international trade in their products continues to threaten populations all over the world.

Atlantic (Kemp's) ridley sea turtle (*Lepidochelys kempii*)

Listed as endangered throughout its range in 1970 by the U.S. and protected in Mexico since the 1960's, the Atlantic ridley was historically a very abundant sea turtle in the Gulf of Mexico fewer than fifty years ago. The population crash that occurred between 1947 and the 1970's may have been the result of intensive over harvesting of eggs and mortality to juvenile and adults in the trawl fisheries.

The Atlantic ridley is the second most abundant endangered sea turtle to be found in the New York Bight study area. Individuals, usually two- to five-year-old juveniles, are commonly found in the eastern part of the Bight from June to October; it is believed that there are a number of significant foraging areas critically important to the large numbers of Atlantic ridleys observed there. These key forage areas include Long Island Sound, Block Island Sound, Gardiner's Bay, and especially the Peconic Estuary. Atlantic ridleys are found to a lesser extent in Jamaica Bay (GATE), Lower New York Bay, and Great South Bay (Sadove 1993-FIIS). In the Bight, Atlantic ridleys feed primarily on green crab (*Carcinus maenas*) and spider crabs (*Libinia* spp.), consuming large quantities and doubling their weight in less than five months. A significant number of the surviving population of 100 to 300 individuals use the Bight annually in their

development cycle; the region therefore is of considerable importance to the survival and recovery of the species.

The federal and NY State governments have listed the Atlantic ridley as an endangered species. In its nonbreeding grounds, commercial shrimping and fishing has also contributed to this turtle's decline as animals become entrapped and drown.

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APPENDIX C

Table C-1. Amphibian and Reptile Species Presence at Coastal and Barrier Network Parks

Common Name	CACO	FIIS	GATE	ASIS	GEWA	SAHI
Spotted salamander	X				X	
Red-spotted newt	X					
Redback salamander	X				X	
Marbled Salamander					X	
Four-toed salamander	MASC					
Eastern spadefoot toad	MAT					
American toad					X	
Fowler's toad	X			X	X	X
Spring peeper	X				X	X
Bullfrog	X			X	X	X
No. Cricket Frog					X	
Gray tree frog					X	
Green tree frog				X	X	
New Jersey chorus frog				X		
Green frog	X			X	X	X
Wood frog	X					
Pickerel frog	X					
So. Leopard frog				X	X	
Leatherback turtle (marine)	*E			X		X
Green turtle (marine)	*E			X		
Loggerhead turtle (marine)	*E			X		X
Hawksbill turtle (marine)	*E					X
At. ridley turtle (marine)	*E					X
Snapping turtle	X			X	X	X
Eastern mud turtle				X	X	
Musk turtle	X					X
Eastern Painted turtle	X			X	X	X
Spotted turtle	MASC			X		
No. diamondback terrapin	MAT			X	X	X
Common Name	CACO	FIIS	GATE	ASIS	GEWA	SAHI
Red-bellied turtle				X	X	
Eastern box turtle	MASC			X	X	X

No. fence lizard				X	X	
Ground skink					X	
No. 5-lined skink					X	
Southeastern 5-lined skink					X	
Six-lined racerunner					X	
Eastern garter snake	X				X	X
Eastern ribbon snake	X				X	X
Northern water snake	X			X	X	
Black racer	X			X		
No. ringneck snake	X					
So. ringneck snake						
Eastern worm snake					X	
Rough Green snake				X	X	
No. brown snake				X		
*Black rat snake				X	X	
Eastern kingsnake					X	
Eastern hognose snake	X			X		
Eastern milk snake	X					

*

**THST- no data available

Table B-2. Massachusetts State Listed Amphibians and Reptiles (CACO)

Amphibians

Jefferson Salamander	<i>Ambystoma jeffersonianum</i>	SC	2
Blue-Spotted Salamander	<i>Ambystoma laterale</i>	SC	3
Marbled Salamander	<i>Ambystoma opacum</i>	T	
Spring Salamander	<i>Gyrinophilus porphyriticus</i>	SC	
Four-Toed Salamander	<i>Hemidactylum scutatum</i>	SC	
Eastern Spadefoot	<i>Scaphiopus holbrookii</i>	T	

Reptiles

Loggerhead	<i>Caretta caretta</i>	T	T
Green Turtle	<i>Chelonia mydas</i>	T	T
Hawksbill	<i>Eretmochelys imbricata</i>	E	E
Atlantic Ridley	<i>Lepidochelys kempii</i>	E	E
Leatherback	<i>Dermochelys coriacea</i>	E	E
Spotted Turtle	<i>Clemmys guttata</i>	SC	
Wood Turtle	<i>Clemmys insculpta</i>	SC	
Bog Turtle	<i>Clemmys muhlenbergii</i>	E	
Blanding's Turtle	<i>Emydoidea blandingii</i>	T	
Diamondback Terrapin	<i>Malaclemys terrapin</i>	T	
Eastern Redbelly Turtle	<i>Pseudemys rubriventris</i>	E	E 4
Eastern Box Turtle	<i>Terrapene carolina</i>	SC	
Eastern Worm Snake	<i>Carphophis amoenus</i>	T	
Eastern Rat Snake	<i>Elaphe obsoleta</i>	E	
Copperhead	<i>Agkistrodon contortrix</i>	E	
Timber Rattlesnake	<i>Crotalus horridus</i>	E	

Birds

Table B-3. New York State Listed Amphibians and Reptiles (For SAHI, GATE, FIIS)

Amphibians

<i>Acris crepitans</i>	Northern cricket frog	E
<i>Ambystoma tigrinum</i>	Tiger salamander	E
<i>Cryptobranchus alleganiensis</i>	Hellbender	U-SC
<i>Eurycea longicauda</i>	Longtail salamander	U-SC
<i>Rana sphenoccephala</i>	Southern leopard frog	G-SC

Reptiles

<i>Caretta caretta</i>	Loggerhead	T
<i>Chelonia mydas</i>	Green turtle	T
<i>Clemmys muhlenbergii</i>	Bog turtle	E
<i>Crotalus horridus</i>	Timber rattlesnake	T
<i>Dermochelys coriacea</i>	Leatherback	E
<i>Emydoidea blandingii</i>	Blanding's turtle	T
<i>Eretmochelys imbricata</i>	Hawksbill	E
<i>Eretmochelys imbricata imbricata</i>	Atlantic hawksbill	E
<i>Eumeces anthracinus</i>	Coal skink	U
<i>Kinosternon subrubrum</i>	Eastern Mud Turtle	E
<i>Lepidochelys kempii</i>	Kemp's or Atlantic ridley	E
<i>Regina septemvittata</i>	Queen snake	E
<i>Sceloporus undulates</i>	Fence lizard	T
<i>Sistrurus catenatus catenatus</i>	Eastern massasauga	E
<i>Trionyx spiniferus</i>	Spiny softshell	U-SC

Table B-4. New Jersey *State Listed Amphibians and Reptiles (For GATE-Sandy Hook Unit)*

Table B-5. Maryland *State Listed Amphibians and Reptiles (For THST, ASIS)*

Table B-6. New Jersey *State Listed Amphibians and Reptiles (For COLO, GEWA)*

Definitions

"Endangered" (E) species are native species that are in danger of extinction throughout all or part of their range, or which are in danger of extirpation from the above listed states, as documented by biological research and inventory.

"Threatened" (T) species are native species that are likely to become endangered in the foreseeable future, or which are declining or rare as determined by biological research and inventory.

"Special concern" (SC) species are native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occur in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened within the above listed state.

Chapter IV. Mammals

Section I. Introduction

Small mammals play a major role in trophic dynamics, consuming plant material and invertebrates, and in turn serving as prey items for a number of species of snakes, raptorial birds and small to mid-sized carnivorous mammals. Through these relationships, small mammals may directly influence population levels of insect pests and disease vectors such as gypsy moths and deer ticks, as well as regionally rare hawks and owls. In addition, through secondary effects, small mammals have the potential to influence species up and down the food chain.

Large mammals can play a major predator role within the food chain. Coyotes are among those species currently being studied within NPS lands.

When populations of non-native species of large mammals such as feral horses or Sika deer reach carrying capacity within a habitat, the results can cause devastation to that habitat. Native species of large mammals such as white-tailed deer can also cause habitat destruction if their populations go unchecked. In the Coastal barrier Network Monitoring Report of 2000, management issues noted included impacts to island habitats from non-native species (Sika deer, horses and invasive species)

Meso-mammals including species such as raccoons and fox can also play a vital role as predators and may be important for controlling human-perceived pest species of small mammals. However, currently, their role in limiting populations of beach nesting birds and turtles is being investigated within some NPS parks.

Marine mammals as a group, are receiving widespread attention on both the Atlantic and Pacific in terms of research concerning their abundance, distribution, life cycles and food habits. Many marine research centers on the Atlantic coast have conducted extensive research on a variety of whales. The marine centers include Center for Coastal Studies (located in Provincetown, MA), The Coastal Research and Education Society of Long Island (located on Long Island, NY) and the Riverhead Foundation (also located on Long Island).

Section II. Conservation Plans

North American Bat Conservation Plan (NABCP)

Land management practices are being implemented throughout the continent, with little or no documentation of their effectiveness in mitigating damage or enhancing habitats for bats. Insufficient knowledge of factors influencing North American bat populations and insufficient data on population status and trends, habitat requirements, and ecosystem roles greatly impede focused and comprehensive recommendations for management.

The North American Bat Conservation Plan (NABCP) is intended to provide the framework and direction for other local, state, and federal bat conservation and management plans. Research goals of the NABCP include identifying key resources such as roosts, drinking and foraging habitats, and flyways; establishing baseline populations and trends; identifying species requirements and limiting factors such as distribution, migratory patterns, and roosting and foraging habitat requirements; describing, quantifying, and monitoring the effects of current land-management practices and other human disturbances on bats; refining spatial and temporal distribution maps, and preparing one set of shared maps for all North American bat species; and encouraging international cooperation and incorporate bats that cross borders into broader wildlife programs such as research, inventory, monitoring, and habitat assessments.

Bat Population Database

This project entailed the development of a relational database on bat populations using the software system "Access", and synthesizing existing information from the published scientific literature and selected state agency databases. Through February 1997 the database had over 6,300 records (each record a count of some category on a particular date at a specific location). This includes records from two state agencies, and about 1700 records, which have been extracted from the published literature (based on review of about 900 sources). The Bat Population Database will serve as a basis for hypothesis testing and statistical analysis, and for designing possible long-term monitoring programs for determining bat population trends. The database will eventually be served on the World Wide Web, but with precise colony locations inaccessible for security against vandalism. For more information, contact: Tom O'Shea, 2150 Centre Avenue, Bldg C; Fort Collins, CO 80526-8118 or go online to: <http://www.fort.usgs.gov/>

Section III. Monitoring Programs and Status of Terrestrial Mammals in Coastal and Barrier Network Parks

ASIS

Table 4-1. Mammal Inventories at ASIS

<i>Mammal Group</i>	<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>Bats</i>		<i>1989</i>	Bashore, Terry L. 1989. Chiroptera survey. University of Maryland Eastern Shore, Coastal Ecology Research Laboratory, Princess Anne, MD.
<i>Delmarva Fox Squirrel</i>			Larson, Bonnie Jean. 1990. Habitat utilization, population dynamics and long-term viability in an insular population of Delmarva fox squirrels (<i>Sciurus niger cinereus</i>). University of Virginia.
<i>Red Fox</i>	<i>Throughout Park</i>	<i>1986</i>	Bashore, Terry L., Krim, Patricia M. 1986. Census and ecological aspects of the red fox breeding population within Assateague Island National Seashore (Maryland Section), April - August 1985. Wildlife Ecology Consultants, Hillsboro, NH.
<i>Red Fox</i>	<i>Throughout Park</i>	<i>1987</i>	Krim, Patricia M. 1987. Ecology of the red fox within Assateague Island National Seashore. Pages 9 p in Editor unknown. Proceedings: Assateague Island Research Symposium. University of Maryland Eastern Shore, Princess Anne, MD?.
<i>Deer</i>	<i>Throughout Park</i>	<i>1984</i>	Tzilkowski, Walter M., Brown, Clifford L. 1984. Abundance of sika and white-tailed deer of Assateague Island National Seashore. U.S. Department of the Interior, National Park Service, Mid-Atlantic Regional Office, Research/Resources Management Report MAR-10; Cooperative agreement number 14-16-0009-1548, Philadelphia, PA.
<i>Deer/Feral Ponies</i>	<i>Throughout Park</i>		Keiper, Ronald R., Hunter, Nick B. 1982. Population characteristics, habitat utilization, and feeding habitats of the feral ponies, sika deer, and white-tailed deer within Assateague Island National Seashore. U.S. Department of the Interior, National Park Service, Mid-Atlantic Region, Research/Resources Management Report Mar-4, Philadelphia, PA.
<i>Feral Ponies</i>	<i>Unknown</i>	<i>1979</i>	Keiper, Ronald R. 1979. <i>Population dynamics of feral ponies. Pages 175-183 in Editor unknown. [Proceedings of the?] Symposium on the Ecology and Behavior of Wild and Feral Horses.</i>
<i>Feral Ponies</i>	<i>Throughout Park</i>	<i>1979</i>	Zervanos, Stam. M. 1979. Seasonal home ranges and activity patterns of feral Assateague Island ponies. Pages 3-14 in Editor unknown. [Proceedings of the?] Symposium on the Ecology and Behavior of Wild and Feral Equids.

<i>Racoons</i>	<i>Unknown</i>	<i>1988</i>	Bashore, Terry L. 1988. Home range and habitat use of raccoons. University of Maryland Eastern Shore, Coastal Ecology Research Laboratory, CERL Research Proposal No. 29, Princess Anne, MD.
<i>Racoons</i>	<i>Unknown</i>	<i>1989</i>	Bashore, Terry L. 1989. Home Range and Habitat Use of Raccoons.
<i>Small Mammals</i>	<i>Throughout Park</i>	<i>1965</i>	Paradiso, John L., Handley, Charles O.=Jr. 1965. Checklist of mammals of Assateague Island. Pages 167-171 in No Author. Chesapeake Science.
<i>Small Mammals</i>	<i>Unknown</i>	<i>1974</i>	Quarles, H. 1974. A preliminary report on the small mammals. National Park Service.
<i>Small Mammals</i>	<i>Unknown</i>	<i>1975</i>	Adkins, Leslie Coleman. 1975. Contributions of habitat selection, interspecific competition and tidal flooding to small mammal species diversity in an Assateague salt marsh. University of Virginia, Charlottesville, VA.
<i>Small Mammals</i>	<i>Unknown</i>	<i>1978</i>	?Dueser, Raymond D. 1978. Species-Habitat Association and Succession Vectors for Small Mammal Populations.
<i>Small Mammals</i>	<i>Unknown</i>	<i>1986</i>	?Dueser, Raymond D., Porter, John H. 1986. Habitat use by insular small mammals: relative effects of competition and habitat structure. Pages 195-201 in No Author. Ecology.
<i>Small Mammals</i>	<i>Chincoteague</i>	<i>1988</i>	Cranford, Jack A., Maly, Mark S. 1988. Small mammal associations on Chincoteague National Wildlife Refuge, Assateague island, Virginia. Pages 111 in No Author. Virginia Journal of Science.
<i>Small Mammals</i>	<i>Chincoteague</i>	<i>?1990</i>	Cranford, Jack A., Maly, Mark S. 1990. Small mammal population densities and habitat associations on Chincoteague National Wildlife Refuge, Assateague Island, Virginia. Pages 321-329 in Martin, James H. Biota of the Virginia Barrier Islands. Virginia Academy of Science, Richmond, VA.
<i>Small Mammals</i>	<i>Throughout Park</i>	<i>1990</i>	Bashore, Terry L. 1990. A checklist to the mammals of Assateague Island. University of Maryland Eastern Shore, Princess Anne, MD.
<i>Marine Mammals</i>	<i>Throughout Park</i>	<i>1994-98</i>	No Author. 1994-1998. No Title. Pages ? in Assateague Island National Seashore. 1994 Marine Mammal and Sea Turtle Stranding Summaries.
<i>Marine Mammals</i>	<i>Throughout Park</i>	<i>2000</i>	Ramsey, Shanna. 2000. Assateague Island National Seashore - Marine Animal Strandings, 2000. 16 Hardcopy and electronic MS Word file (Unpublished).

ASIS Mammal Monitoring Programs

The current long-term monitoring programs for mammals on ASIS include feral horses population dynamics, Feral Horse Grazing Effects and Sika Deer Hunting Takes (since early 1980's) being conducted through the National Park Service (pers. communication, Carl Zimmerman).

CACO

Table4-2. Mammal Inventories at CACO

<i>Mammal Group</i>	<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
? All Mammals	Throughout Park	1977	Lazell, J.D. =Jr. 1977. Resident mammals of Cape Cod: A preliminary checklist. U.S. Department of Interior, National Park Service, Cape Cod National Seashore, South Wellfleet, MA.
?All Mammals	Throughout Park	1990	Jones, Kyle. 1990. Mammal Inventory, Cape Cod National Seashore.
Small Mammals	Throughout Park	2000, 01	Cook, R.P., Boland, K. 2001. Small Mammal Monitoring at Cape Cod National Seashore. pages (Unpublished).

Mammal Monitoring Programs at CACO

Currently, protocol for a canid/meso-mammal project is being developed. This work will include monitoring fox and coyotes. Alan O'Connell (USGS) will conduct this work. In addition, Bob Cook and Kelly Boland of the NPS have conducted small mammal monitoring to determine their abundance, distribution, and habitat relationships since 2000. Two sites/habitat in heathland, wetland, grassland, oak forest and pine forest were sampled. At each monitoring site, 100 Sherman live traps were deployed at 10 m intervals in a 90 X 90 square grid. Two sites were trapped each week, with five weeks required to complete a round of sampling at each of the 10 sites. A total of four rounds of sampling was conducted (late spring, early, mid and late summer). Total trapping effort was 1,500 trap nights/sites, for a total of 15, 000. All animals captured were identifies to species, weighed, measured, sexed, aged, marked with a PIT tag and then released at point of capture.

Preliminary analysis suggest that small mammal abundance is greatest in woodland and wetland habitats and lowest in grassland and heath. Distribution of species among habitats is fairly consistent with known affinities. Certain species are widespread, but vary in abundance between habitats, probably as a result of food habits. The granivorous white-footed mouse appears to be the most abundant in woody dominated habitats and least in herbaceous-dominated ones. For the herbivorous meadow vole, the pattern is reversed. Other species appear to show stronger habitat affinities, masked shrew with wetlands, meadow jumping mouse with herbaceous habitat and red-backed vole with oak forest. This latter was surprising, given the red-backed vole's known association with coniferous habitats and may be due to the xeric nature of pine habitats on Cape Cod. With additional data collection in the coming years, further insight into habitat relationships, as well as trends in abundance will be more apparent.

COLO

Table 4-3. Mammal Inventories of COLO

<i>Mammal Group</i>	<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>Deer</i>	<i>Jamestown Island</i>	<i>1962</i>	U.S. Department of the Interior, National Park Service. 1962. Deer count-Jamestown Island. National Park Service.
<i>Deer</i>	<i>Unknown</i>	<i>1985</i>	Author unknown? (no author included in original record). 1985. Deer survey. National Park Service, Yorktown, VA.
<i>Woodchuck</i>	<i>Throughout Park</i>	<i>1986</i>	Baril, Peter E. 1986. Ground hog monitoring and management. National Park Service, Yorktown, Virginia.
<i>All</i>	<i>Throughout Park</i>	<i>1991</i>	Virginia Division of Game and Inland Fisheries, Giles, Robert H. 1991. Biota of Virginia, animals of Colonial National Historical Park, 08-08-91.

Mammal Monitoring Programs at COLO

GEWA

Table 4-4. Mammal Inventories at GEWA

<i>Mammal Group</i>	<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>All Mammals</i>	<i>Throughout Park</i>	<i>1970</i>	Author unknown. 1970. Survey of vertebrates, George Washington Birthplace National Monument. National Park Service, Washington's Birthplace, VA.
<i>Deer</i>	<i>Throughout Park</i>	<i>1988</i>	Author unknown. 1988. Deer census techniques, maps, routes, results for GEWA. National Park Service, Washington's Birthplace, VA.
<i>All Mammals</i>	<i>Throughout Park</i>	<i>1991</i>	Eckerlin G. 1991. Mammals of George Washington Birthplace National Monument (Not listed in NRBIB)

A three-year survey of the mammals of the George Washington Birthplace National Monument, Westmoreland County, Virginia was conducted from March 1986-April 1989. (Eckerlin 1991) Small mammals were sampled primarily by trapping with Sherman and Hav-a-hart traps. Museum special snap-back traps and larger rat-traps were used occasionally. Large mammals were observed via walking or driving. Mist nets were used on two occasions to sample bats. Observations were made in all months of the year except December. Twenty-four days of observing were performed with 1-13 observers. Sampling involved 13 nights of trapping. Approximately 480 man hours were spent in the field. Twenty -two species of mammals belonging in 12 families of seven orders were observed and collected (Table C-1).

Mammal Monitoring Programs at GEWA

Currently, there are no mammal NPS monitoring programs occurring at GEWA (pers. communication Rijk Morawe, GEWA Resource Manager)

THST

No known inventories of mammals or monitoring programs for mammals have occurred at THST (pers. communication ?Rijk Morawe, THST Resource Manager).

FIIS

Table 4-5. Terrestrial Mammal Inventories of FIIS

Mammal Group	Location in Park	Year(s)	Bibliography
All Mammals	Throughout Park	Unknown	U.S. Department of Interior, National Park Service, Fire Island National Seashore. No Date. Mammals commonly and not commonly seen on Fire Island. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY. 1 p.
Land Mammals	Unknown	1968	Anonymous. 1968. The natural history of Long Island - the land mammals. Sanctuary [Long Island Chapter of Nature Conservancy]: 2-19.
All Mammals	Unknown	1971	Connor, P.F., Benton, A.H., Kelly, D.L. 1971. The mammals of Long Island, New York. Bulletin No. 416, New York State Museum and Science Service, State University of New York, Albany, NY. 78 pp.

Table 4-6. Marine Mammal Inventories of FIIS

Marine Mammal Group	Location	Year(s)	Bibliography
Marine Mammals	Fire Island	Unknown	U.S. Department of Interior, National Park Service, Fire Island National Seashore. No Date. A few marine animals common to the waters adjacent to Fire Island. Unpublished, U.S. Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY.
Unknown	Long Island	Past	McKasty, Lisa, Sadove, Samuel. 1984. Historic Strandings on Long Island. Okeanos. Vol. 2: p. 18.
Whales	Fire Island	Past	Madonia, Therese. 1985. Fire Island's Whaling Industry; As Recorded by Martha Turnstall Smith. Fire Island Tide. p. 19-20.
Marine Mammals	Massachusetts to North Carolina	1973	Pilson, M.E.Q., Goldstein, E. 1973. Marine mammals, pp. 7-1 - 7-48. in: Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals. Marine Publication Series 2, University of Rhode Island, Kingston, RI.
Whales	Long Island	1981	Quackenbush, Roger E. 1981. A Guide to Some Long Island Whales. The Conservationist. Vol. 35 No. 6: p. 18-21.
Cetaceans	Northeast U.S.	1986	Kenney, R.D., Winn, H.E. 1986. Cetacean high-use habitats of the northeast United States continental shelf. U.S. Fishery Bulletin 84(2):345-357.
Marine Mammals	New York	1992	Sadove, Samuel S. 1992. Annual Report: Marine Mammal and Sea Turtle Stranding Program. Okeanos Ocean Research Foundation, Return a Gift to Wildlife Program Contract No. C001983, NY.

As a taxa expert and a FIIS staff member, Ernest Taylor spent time reviewing the park's existing mammal data and felt that 90% of the existing species have been documented. Ernie has a background in mammalogy and wildlife biology. He has described Fire Island as having very complete small mammal data, including population densities for all common species as well as habitat associations based on vegetation classification work done by McCormick et al. (1975) (Stevens-Nerone, 2001). Other inventory work that included mammals were Lynch's Ecological Inventory of the William Floyd Estate (Lynch, 1984) and Northup's 1986 inventory of small mammals on FIIS. Ernie had planned to do some work in the park to fill in distributional gaps in mammal information and to gather further information on insectivores (Stevens-Nerone, 2001).

Terrestrial Mammal Monitoring Programs at FIIS

Small Mammal Research & Monitoring

This project conducted by H.B. Underwood from 1994-2001 primarily focused on assessing the demography (density, population composition, and dynamics) of white-tailed deer and common mice on the Lighthouse Tract of Fire Island National Seashore. Webs of 208 Sherman live-traps were used to assess small mammal abundance and species composition. An average of 5000 trap nights were logged each summer (May-October). Density, home range and dispersal patterns were derived for several common species.

White Tailed Deer Research & Monitoring

From 1988-98 research has been ongoing to assess the population dynamics and ecological impacts of white-tailed deer living within the authorized boundary of Fire Island National Seashore. Research indicates deer density throughout western Fire Island has increased from less than 5 deer/km² to more than 80 deer/km² since observations have been made (late 1960s to present (Underwood, 1998). The dramatic increase in deer numbers over the last several decades has been largely attributed to two factors. First, mortality due to predators, hunting and poaching, and deer-vehicular collisions on Fire Island is virtually non-existent. In particular, the establishment of the Seashore in 1964 and ensuing Federal presence ostensibly curtailed or eliminated poaching which, according to local lore, was pervasive. Second, deer have widespread access to non-natural food sources. This includes intentional feeding by residents and visitors, feeding upon ornamental and garden plants on private property, and opportunistic feeding on garbage. This feeding, combined with low mortality increased the number of deer across western Fire Island at an average annual rate exceeding 23% between 1983-91. Today, the feeding of deer by residents and visitors has become a culturally ingrained activity and sympathy for the well being of deer, especially during the winter, is intense. Consequently, the number of deer capable of being supported in a relatively small land area is considerably greater than in other areas of FIIS where deer numbers are less affected by the activities of humans.

In 1993, a research project funded largely through private donations to the Humane Society of the United States (HSUS) was initiated on Fire Island to explore the use of emerging wildlife contraceptive technologies on a free-ranging population of deer. As its principal objective, the project sought to determine if (1) the technology could be employed for an unconfined population of wild animals, and (2) the contraceptive agent could produce a measurable

reduction in fertility among treated females. Both objectives were substantially affirmed over the first five years of study.

Because baiting of deer is of fundamental importance for the efficient treatment of large number of females, the program will become more sustainable over the long run as the National Park Service relocates baiting stations onto public lands. Moving the stations will hopefully shift the deer away from the communities and reduce the potential for deer-human conflict and raise public acceptance of the program. This will, in addition, allow for closer regulation of the timing and amount of bait provided, potentially minimizing feeding and its impacts on deer behavior and population dynamics.

GATE

Table 4-7. Mammal Inventories at GATE

<i>Mammal Group</i>	<i>Location in Park</i>	<i>Year(s)</i>	<i>Bibliography</i>
?All Mammals	Unknown	1971	Connor, P.F., Benton, A.H., Kelly, D.L. 1971. The mammals of Long Island, New York. Bulletin No. 416, New York State Museum and Science Service, State University of New York, Albany, NY. 78 pp. No Title.
All Mammals	Great Kills Park	1975	U.S. Department of Interior, National Park Service, Gateway National Recreation Area. 1975. Mammals occurring at Great Kills Park, Gateway National Recreation Area. Unpublished, U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Staten Island Unit, Staten Island, NY. 4 pp.
?All Mammals	JBNWR, Breezy point, Sandy Hook	1980	O'Connell, Allan. 1980. The relationships of mammals to the major vegetation communities in the Gateway National Recreation Area (Jamaica Bay Wildlife Refuge, Breezy Point, and Sandy Hook) including a soil analysis of selected areas. Gateway Institute for Natural Resource Sciences, National Park Service, Master's Thesis. New York University, New York, NY. GATE-N-012-11, unknown.
All Mammals	Sandy Hook	1989	McArthur, Jeanne. 1989. Mammals of Sandy Hook. 8 pp.

Mammal Monitoring Programs at GATE

SAHI

No Mammal Inventories listed for Sagamore Hill National Historic Site. Currently, there are no mammal NPS monitoring programs occurring at SAHI

Section IV. Marine Mammals

The Marine Mammal Protection Act of 1972 (MMPA) was most recently reauthorized in 1994. In passing the MMPA in 1972, Congress found that:

- certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities;
- such species and population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population level;
- measures should be taken immediately to replenish any species or population stock which has diminished below its optimum sustainable level;
- there is inadequate knowledge of the ecology and population dynamics of such marine mammals and of the factors which bear upon their ability to reproduce themselves successfully; and
- marine mammals have proven themselves to be resources of great international significance, aesthetic and recreational as well as economic.

The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. The term "take" is statutorily defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." Under the 1994 amendments, the Congress statutorily defined and divided the term "harassment" to mean any act of pursuit, torment, or annoyance which --

Level A Harassment- has the potential to injure a marine mammal or marine mammal stock in the wild; or

Level B Harassment- has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption or behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

Under the MMPA, the Secretary of Commerce is responsible for the conservation and management of pinnipeds (other than walruses) and cetaceans. The Secretary of Commerce delegated MMPA authority to the conservation and management of living marine resources (LMR's) in the United States is entrusted to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS).

Part of the responsibility that NMFS has under the MMPA involves monitoring populations of marine mammals to make sure that they stay at optimum levels. NMFS recovers protected marine species, such as sea turtles, whales and dolphins, without unnecessarily impeding economic and recreational opportunities. It supports the development of innovative management

strategies and technologies to reduce potential conflicts involving protected species. It develops and implements conservation and recovery plans, and works to prevent species from becoming threatened or endangered. Recovery plans for federally listed species can be located at:

http://www.nmfs.noaa.gov/prot_res/PR3/recovery.html

If a population falls below its optimum level, it is designated as "depleted," and a conservation plan is developed to guide research and management actions to restore the population to healthy levels. For information on species that are considered depleted under the MMPA, go to:

http://www.nmfs.noaa.gov/prot_res/PR2/depleted.html/.

In 1994, Congress amended the MMPA, establishing a new regime to govern the taking of marine mammals incidental to commercial fishing operations. This new regime included the preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction, development and implementation of take reduction plans for stocks that may be reduced or are being maintained below their optimum sustainable population levels due to interactions with commercial fisheries, and studies of pinniped-fishery interactions.

Since the 1994 Amendments became law, NMFS has published several regulations to implement requirements under the Act. These include the general authorization for scientific research, the new management regime for governing the incidental taking of marine mammals in commercial fisheries, the prohibition on intentional lethal take in commercial fishing, the prohibition on approach closer than 100 yards to humpback whales in Hawaii, and consolidation of regulations for special exception permits to take, import, export, or carry out any other otherwise prohibited act involving marine mammals for the purpose of scientific research or enhancement for the survival or recovery of a species or stock.

Information about NMFS' implementation of the 1994 Amendments to the MMPA can be found in the quarterly MMPA Bulletin, as well as in the MMPA Annual Report to Congress.

The complete text of the Marine Mammal Protection Act is also available, as retrieved from the U.S. Code Server, at the U.S. House of Representatives Internet Law Library.

The NMFS Office of Protected Resources (OPR) is charged with the implementation of the Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and the Fur Seal Act (FSA) with respect to marine mammal species under NOAA Fisheries jurisdiction- whales, dolphins, porpoises, seals, and sea lions. As part of the MMPA mandate, OPR works in collaboration with the NOAA Fisheries Regions and Fisheries Science Centers to develop and implement a variety of programs for the protection, conservation, and recovery of marine mammals. OPR also establishes cooperative agreements with states and Alaska Natives regarding marine mammal resources, identifies important research needs to collect appropriate information for management decisions, and administers the activities of the Marine Mammal Health and Stranding Response Program.

Section IV.1 Marine Mammal Initiatives

NMFS Northeast Fisheries Science Center Marine Mammal Sighting Surveys:

Shipboard sighting surveys of marine mammals involve directing the vessel along a predetermined transect, and counting the number of each marine mammal species sighted. Sighting surveys have been conducted to evaluate the abundance and distribution of the marine mammal community in coastal shelf waters, and those associated with the western boundary of the Gulf Stream. Marine mammal sightings are routinely conducted as a "piggy-back" activity on bottom trawl and larval fish survey cruises.

NMFS Center for Coastal Fisheries and Habitat Research

The Center monitors protected sea turtles and marine mammals. Information gathered includes overall characteristics (e.g., age, sex) genetic structure, habitat requirements, and navigational cues. For more information, go online to:
<http://www.nccos.noaa.gov/about/ccfhr.html/>

Protected Resources' Marine Mammal Program

The Marine Mammal Health and Stranding Response Program (MMHSRP) was established in the late 1980s in response to growing concern about marine mammals washing ashore in U.S. waters. The MMHSRP goals are: to facilitate collection and dissemination of data, to assess health trends in marine mammals, to correlate health with available data on physical, chemical, environmental, and biological parameters, and to coordinate effective responses to unusual mortality events. For a copy of the Marine Mammal Health and Stranding Response Program: Program Development Plan (PDF), go to:

http://www.nmfs.noaa.gov/prot_res/readingrm/MMHealth/mmhealth.pdf

This program was formalized by the 1992 Amendments to the Marine Mammal Protection Act, and the National Marine Fisheries Service (NMFS) was designated as the lead agency to coordinate related activities. The program has the following components: stranding networks, responses/investigations of mortality events, biomonitoring, tissue/serum banking and analytical quality assurance.

Stranding Networks

To respond to marine mammal strandings, volunteer stranding networks were established in all coastal states and are authorized through Letters of Authority from the NMFS regional offices. Through a National Coordinator and five regional coordinators, NMFS oversees, coordinates, and authorizes these activities and provides training to personnel. Table C-3 lists Northeast Stranding Networks.

Biomonitoring

In recent years, high concentrations of potentially toxic substances in marine mammals and an increase in new diseases have been documented, and scientists have begun to consider the

possibility of a link between these toxic substances and marine mammal mortality events. These studies contribute to a growing, worldwide effort of marine mammal biomonitoring not only to help assess the health and contaminant loads of marine mammals, but also to assist in determining anthropogenic impacts on marine mammals, marine food chains and marine ecosystem health. NMFS provides participants in the program with training and some financial support. Using strandings, and bycatch animals, the participants provide tissue/serum archiving, samples for analyses, disease monitoring and reporting and additional response during disease investigations.

The Analytical Quality Assurance (AQA)

This aspect of the MMHSRP was designed to ensure accuracy, precision, level of detection, and intercomparability of data in the chemical analyses of marine mammal tissue samples. The AQA consists of annual interlaboratory comparisons and the development of control materials and standard reference materials for marine mammal tissues. The new NIST Charleston facility is taking the lead for this activity.

Response to Unusual Mortality Events

In response to the 1987-88 dolphin die-off, NMFS established a Working Group on Unusual Marine Mammal Mortality Events to create criteria for determining when an unusual mortality event is occurring and then to direct responses to such events. The Working Group is periodically called upon to lend its expertise in situations where circumstances indicate an unusual mortality event may be occurring and may provide guidance throughout the event. This Group meets annually, and at the last meeting discussed many issues including recent mortality events involving endangered species both in the United States and abroad. Through consultation with other government agencies, the Working Group has been able to build on its existing knowledge of mortality events to better respond to unusual marine mammal mortality event.

National Marine Mammal Tissue Bank

The National Marine Mammal Tissue Bank was formally established in 1992 and provides protocols and techniques for the long-term storage of tissues from marine mammals for retrospective contaminant analyses. The Tissue Bank is currently expanding at the Ft Johnson NOAA facility in Charleston, South Carolina. The Tissue Bank uses the biomonitoring sites noted above and other trained personnel to collect tissues on specific indicator species (Atlantic bottlenose dolphins, Atlantic white sided dolphins, pilot whales, harbor porpoise), mass stranding animals, and mortality events. In addition, a serum bank and long-term storage of histopathology tissues are being developed.

Marine Mammals Ashore CD-ROM

Through a cooperative effort between the NMFS Office of Protected Resources, National Ocean Service's Office of Ocean Resources Conservation and Assessment, and the National Aquarium in Baltimore, *Marine Mammals Ashore: A Field Guide for Strandings* by Geraci and Lounsbury has been adapted into a CD-ROM format. The CD-ROM includes the entire original publication in PDF, as well as updated information, stranding forms, and a multimedia overview including interactive discussions by marine mammal experts from around the world. The CD-ROM is compatible with most PC and Macintosh computers.

Marine Mammals Ashore: A Field Guide for Strandings was originally published in 1993 as one of the most comprehensive guides for marine mammal stranding response and rehabilitation ever compiled. Since its initial publication, this field guide has provided countless numbers of marine mammal rehabilitators and scientists around the world with information vital to successful response, rehabilitation, and release of marine mammals.

To purchase this CD-ROM, please contact Valerie Lounsbury at the National Aquarium in Baltimore by e-mail at: vlounsbury@aquaria.org or by mail at: Pier 3, 501 East Pratt Street, Baltimore, MD 21202-3194. You can also purchase the CD-ROM online from the National Aquarium in Baltimore.

For more information regarding the Marine Mammal Health and Stranding Response Program, go online to: http://www.nmfs.noaa.gov/prot_res/overview/mm.html

Center for Coastal Studies

The Center for Coastal Studies (CCS) was founded in 1976 in Provincetown, Massachusetts. The first work of CCS, which began as a largely voluntary organization of concerned scientists and citizens, involved issues of coastal erosion and planning. Over the years, it has evolved into a small field station concentrating on various aspects of applied research in the marine environment, mostly having to do with marine mammals.

For over a decade, CCS has looked into the factors that make Cape Cod Bay a critical habitat for right whales. They are focusing on the following questions: How do these patches form? How do whales find these patches? Why does the composition of zooplankton change from year to year? How would changes in the health of the Bay affect zooplankton and therefore the population of right whales? What is the carrying capacity of the Bay (how many whales can the habitat support)?

Massachusetts Division of Marine Fisheries Conservation Program

The Massachusetts Division of Marine Fisheries (DMF) Conservation Program was established in 1997 with input from the Massachusetts Endangered Whale Working Group. The Working Group was appointed by the federal court and charged with devising measures to minimize harm to Northern Right Whales in state waters. DMF's efforts dovetail with ongoing federal, state and private programs to protect right whales.

DMF's efforts include research, management, and education components. The keystone of the program is the Surveillance and Monitoring Program where experienced right whale researchers from the Center for Coastal Studies and DMF biologists survey and monitor the presence of Right Whale Critical Habitat and adjacent waters. Mariners are warned about the presence of right whales through the federal Sighting Advisory System. To reduce the threat and harm from entanglement with fixed fishing gear, DMF's gear experts are studying lobster and gillnet gears and prescribing changes. Fishermen are cooperating by testing various gear configurations that are whale-friendly and yet safe for fishing operations. Anytime a large whale is observed entangled, CCS responds to the situation under the federally-funded Disentanglement Program.

Finally, DMF, CCS, federal agencies and others are all working to raise the profile and awareness about the plight of this highly endangered whale.

Years of the North Atlantic Humpback

The Years of the North Atlantic Humpback (YoNAH) project is an international collaboration to study North Atlantic humpback whales across most of their known range. It was conceived to address large-scale issues, such as the size and structure of the population, vital rates, migratory movement and the structure of the mating system. The project involved two intensive years of field research. During the summers of 1992 and 1993, intensive photographic and genetic sampling was performed concurrently in five high-latitude feeding grounds: the Gulf of Maine (U.S.), Canada, Greenland, Iceland and Norway. During the winter months, field work was performed in the West Indies, a shared, low-latitude breeding ground. Sampling techniques were standardized within and between areas to ensure data comparability and to minimize sampling bias. A central archive was established for all photographs, tissue samples and data to facilitate analysis and to provide a valuable legacy for future investigators. YoNAH participants in the United States are The Center for Coastal Studies, College of the Atlantic and the National Marine Fisheries Service, NEFSC.

Coastal Research and Education Society of Long Island

Scientists from Coastal Research and Education Society of Long Island (CRESLI) have been studying cetaceans (whales, dolphins and porpoises) for over two decades. Samuel Sadove and more recently Dr. Artie Kopelman, have been investigating fin whale behavior and conducting population and distribution surveys for all cetaceans in New York's waters. A number of students from Southampton College and other colleges, as well as volunteers from all walks of life assist with data collection and analysis.

CRESLI's cetacean research goals are multifaceted, and mainly directed at photo identification (particularly of fin whales, sperm whales and humpback whales) and collection and analysis of basic ecological and behavioral data from all cetacean species encountered.

Data collected by CRESLI scientists over 20 years indicate that approximately 25 species of cetaceans utilize Long Island's waters, including fin whales, humpback whales, minke whales, North Atlantic right whales, sei whales, blue whales, sperm whales, pilot whales, as well as common dolphins, bottlenose dolphins, striped dolphins and white sided dolphins.

CRESLI's goal is to provide much needed information about population sizes, genetic affinities, and the distribution and abundance of cetacean species utilizing Long Island waters. CRESLI's cetacean research program includes several comprehensive projects:

Cetacean population and distribution

Using shipboard and aerial platforms, the species, number of individuals, and their locations are recorded, along with meteorological and other data. Over time this serves to give researchers a picture of general population and distribution trends, and how cetaceans utilize their habitat.

Sighting Network

Local commercial and recreational fishermen and boaters are asked about sightings of cetaceans. This information supplements data collected by CRESLI researchers.

Photo identification of individual fin whales

CRESLI researchers developed a method of identifying individual animals by photographing each whale's chevron pattern, dorsal fin, and any other distinguishing features. These photographs, along with observed behavioral data, are used to study individual animals and determine population numbers and distribution.

Fin whale biology and behavior

Intensive studies of fin whale feeding behavior and prey species, movement patterns, and behavior.

Section IV. 2. Status of Marine Mammals along the Atlantic Coast (with focus on New York coastal waters)

The following information regarding the status of marine mammals along the coast was largely obtained from the 1997 document Significant Habitats and Habitat Complexes of the New York Bight Watershed (USFWS 1997).

The NY coast has one of the highest diversities of marine mammals reported anywhere in the United States, and supports many threatened and endangered species. The NY coast is also a significant wintering habitat for the growing population of harbor seals and for a smaller though increasing number of other northern Atlantic seals such as grey, harp, and hooded seals, expanding their ranges to the south. Finback, humpback, and minke whales utilize these waters frequently, and sperm whales are regularly sighted in the late spring. The critically endangered right whale migrates through the area and, on occasion, feeds along the NY coastline. Dolphin species, including common, bottlenosed, white-sided, and striped, as well as pilot whales, are often encountered in these waters.

Although five species of seal can be found on Long Island's shores, only the harbor seal is common on Long Island. Anecdotal stories suggest that harbor seals were quite abundant on Long Island up to the mid 1900's. In the early 1980's harbor seals were seen in small numbers mainly on remote beaches and islands. Estimates of the total winter population were thought to be several hundred with less than 15 strandings each year. In following years more and more sightings were reported and strandings rose dramatically, with well over 100 seals stranded each year. In 1995 there were 157 strandings. The elimination of seal hunting in the continental US and much of Canada may be a factor in the increase of seal populations. Population increases north of Long Island may mean that these animals are extending their range southward to Long Island. Harbor seals, like most other seal species, migrate southward every winter, returning to New England and Canada in the summer. On Long Island a large influx of these seals arrive in November and remain through mid- May, although some are thought to stay throughout the year.

Grey seals used to be uncommon winter visitors, but now are regularly seen in small numbers, with pups often stranding in March and April. Until recently Arctic species such as harp and hooded seals rarely ventured south of northern Maine. Now more of these seals are stranding on Long Island's beaches every year. In the 1994-5 season, the number of stranded harp seals actually exceeded harbor seals. In addition, a small number of ringed seals, another Arctic species, have stranded here.

Harp seals migration roughly follows the edge of the pack ice that retreats northward in the summer and moves south in winter. This species has endured intense hunting since the 16th century. After Canadian Fisheries scientists discovered that the harp seal's population had become drastically reduced in the 1950's, the Government instituted quotas to reduce the killing. Public attention became focused on this massive slaughter, particularly of the white coated pups off the coast of Newfoundland every March. Public outcry and political

pressure eventually put a stop to the hunt in 1987, but the hunt began again in the mid 1990's.

Hooded seals are a less numerous seal than the harp, but inhabit the same regions of the world. These seals feed on fish, squid, shrimp and mussels. They are large and very distinct in appearance. Hooded seal juvenile pelts were extremely desirable to sealers who sold the pelts to furriers for coats. Several juveniles come ashore on Long Island every year, often exhausted, and sick. They are rehabilitated and released back to sea.

Ringed seals are a very common seal. They are found throughout the Arctic wherever there is stable ice near land, especially in bays, but also in lakes and river openings. Ringed seals feed mainly on polar cod and shrimp-like animals. Population estimates for ringed seal are between 3 ½ to 6 million, which makes them the most abundant of the Arctic seals.

Blue whale (*Balaenoptera musculus*)

The blue whale, listed as endangered since 1978, is the largest living mammal in the world. Usually occurring singly or in pairs, individuals are difficult to identify at a distance, especially when associated with groups of finback whales. Blue whales are considered shallow feeders, feeding on krill (euphausids) distributed in the ocean's surface (100 meters [328 feet]) layers. Okeanos Foundation has documented fewer than a dozen sightings in the New York Bight in the past 15 years. The sightings have occurred at least 40.2 kilometers (25 miles) south of Montauk Point in waters deeper than 30 meters (98.4 feet).

Finback whale (*Balaenoptera physalus*)

The finback whale is the most abundant and widely distributed baleen whale along the Mid- and North Atlantic coasts. Finback whales were listed as endangered under the Endangered Species Act in 1970. Present in the northern waters of the Atlantic Ocean year-round, they are found during spring and summer in one of five principal use areas: Lower Bay of Fundy, Jeffrey's Ledge, and Stellwagen Bank in the Gulf of Maine, and Great South Channel and Cox's Ledge off the coast of Massachusetts. These principal use areas are rich in food species such as calanoid copepods and euphausids, as well as schooling fish (Atlantic herring, Atlantic mackerel, sand lance, butterfish, Atlantic menhaden, and alewife) and invertebrate species (longfin and northern shortfin squid). Feeding aggregations usually involve 20 or more individuals, and groups of over 200 finback whales are not uncommon. In the fall through early winter, finback whales are more abundant in the New York area as they move offshore along the continental shelf near the 200 meter (656.2 foot) contour. Finback whales breed in the winter, mostly in temperate waters. Mid-winter through early spring, they are found within a mile of the shoreline along the eastern portions of Long Island and the New York Bight Apex, apparently feeding on the high densities of herring and mackerel that occur there at this time of year. Winter aggregations involve small groups of 3 to 4 individuals. Calves are observed throughout the year, with newborn calves appearing in early July in the New York region; there is some speculation that calving may be occurring in this area.

The finback whale is one of the fastest of the large whales, and is able to reach burst speeds of over 37 kilometers/hour (20 knots/hour). They were not an important commercial species until the comparatively recent development of fast catcher boats and the depletion of the blue whale stock. Today they are subject to stresses in the marine environment caused by anthropogenic sources, including habitat degradation from coastal development and pollution, competition for resources, entrapment and entanglement in fishing gear, and collision with ships.

Sei whale (*Balaenoptera borealis*)

The sei whale has been listed as endangered under the Endangered Species Act since 1970. Little is known regarding the distribution and migrations of this large whale. They are generally sighted north of 40°N latitude, centering their distribution on the perimeter of Georges Bank. Sei whales feed primarily on copepods, euphausiids, and a variety of small schooling fishes. Sei whales are infrequently sighted in the New York area; however, they have been found occasionally in association with finback whale aggregations, and sightings along the New York coast are principally in the months of July and August. Sei whales primarily use the New York coast for foraging; it is unknown if any other activities take place here.

Northern right whale (*Eubalaena glacialis*)

Right whales are sighted regularly every year along the New York coast. Most sightings are in the months of March through June as the animals move through the region on their migration route north. Occasionally several have been observed feeding in association with large blooms of calanoid copepods. Based on Okeanos Foundation data, New York waters function mainly as a migration pathway, with sightings of cow/calf pairs and solitary individuals occasionally feeding on their journey to summering grounds in Cape Cod Bay.

CCS data provided the scientific basis for the creation of the Stellwagen Bank National Marine Sanctuary and federal designation of Cape Cod Bay as a Critical Habitat for the North Atlantic right whale, one of the most endangered marine mammals in the world, with less than 350 animals remaining.

Until about thirty years ago, the North Atlantic population was believed to be extinct. It was listed as endangered under the Endangered Species Act in June 1970. Since the discovery of a relic population, research and conservation have focused on learning more about right whales and their habitat requirements. The right whale population in the North Atlantic currently includes between 300 and 350 individuals. The low population numbers signal that this large whale species is most in danger of extinction in the near future. Possible reasons for non-recovery include effects of ship traffic, marine pollution, coastal development in the North Atlantic calving grounds, entanglement with fishing gear, collision with vessels, and competition for food with other copepod-eating whales and fish. How the population might be affected by habitat degradation is being studied through long term research efforts at CCS, by collaborating research labs and government agencies along the eastern seaboard.

Right whales move between rich summer feeding grounds and warm winter calving grounds. During summer and fall most of the population feeds on different banks in Southeast Canada such as the Bay of Fundy. "Courtship groups" are also seen at this time. During November and

December right whales almost disappear with a few scattered reports coming from far flung areas such as Jeffrey's Ledge off Northern Massachusetts and offshore of Cape May, New Jersey. By late winter and early spring, two distinct aggregations appear: calving females off southern Georgia/northern Florida and non-calving animals feeding the Massachusetts coast (Cape Cod Bay, Great South Channel and Nantucket Sound).

During the winter months the wide, shallow bay, protected by the arm of Cape Cod, creates the perfect habitat for blooms of phytoplankton, the basis of a complicated and poorly understood food web. Right whales, searching for food, become part of this habitat.

Cape Cod Bay is not the only known feeding ground of right whales but it is the only known habitat where the whales are commonly found feeding at the surface. The unique situation of Cape Cod Bay affords researchers with the opportunity to do fine scale studies of right whale habitat requirements. Experimental stations within Cape Cod Bay are monitored for a series of environmental characteristics, including: salinity, ambient light, temperature, phytoplankton and zooplankton. Coupled with sightings of right whales, these environmental factors create an image of how right whales use the Bay.

What has been found is that right whales feed upon a host of zooplankton, most notably, the crustaceans called copepods. The occurrence of different copepods is tied to such environmental factors as temperature, salinity and availability of their prey, including phytoplankton and other zooplankton. Since all of these factors change through the season and throughout the Bay, the diversity and density of copepods differs over time and space. This patchiness of copepods affects the movements of feeding right whales. The habitat studies team has begun to define the composition of these patches (their size and density), and their occurrence throughout the Bay.

Humpback whale (*Megaptera novaeangliae*)

The humpback whale is distributed worldwide, but is less common in Arctic waters. This species was classified endangered when the U.S. Endangered Species Act was passed in 1973 and remains so today. Humpbacks are numerically the fourth most depleted large cetacean worldwide; they were heavily exploited by commercial whalers until the middle of this century. Commercial hunting ceased in 1955 in the North Atlantic and in all oceans by 1966. Today these whales meet with a number of other threats, including entrapment and entanglement in fishing gear, collision with ships, acoustic disturbance, habitat degradation from both pollution and coastal development, and competition for resources with humans.

All humpbacks feed in a summer range that is located over the continental shelf at latitudes ranging from about 40 to 75° north. Many of its summer habitats are traditional, although there are within-season movements, presumably to find or follow concentrations of prey.

The humpback whale is regularly found in the New York coastal area; however, its abundance fluctuates widely. Humpbacks are often found in shallow water and have been observed within Long Island Sound (SAHI) for periods exceeding a week. This is one of the few species that has been observed frequently along western Long Island (GATE), inclusive of the New York Harbor and the surrounding shore. Concentration of prey items, sandlance, herring, and Atlantic mackerel, seems to attract these humpbacks, regardless of location. The greatest abundance of humpback whales in the New York Bight occurs as they feed on small schooling fish

concentrations from June through September, and again in December and January. Based on Okeanos Foundation surveys, there are never more than 50 to 100 animals at any one time in the New York Bight.

These whales undertake long-distance migrations between summer feeding and winter breeding areas. Most humpback whales return to traditional winter locations at the lower latitudes, usually between 10 and 35° north.

Sperm whale (*Physeter catodon*)

The sperm whale was listed as endangered under the 1973 Endangered Species Act. It is distributed widely throughout the deep waters of the North Atlantic, somewhat concentrated along the 1,000-meter (3,281-foot) contour and almost always in waters greater than 200 meters (656.2 feet). Sperm whales are deep-water feeders that rely on squid (*Illex* spp.) as their mainstay prey; however, they will also eat a variety of deep-water fishes, including sharks, rays, anglers, lumpfish, and rockfish.

The deeper waters of the New York Bight seem to be important to the various life stages of the sperm whale; a great many sightings of individuals have been reported in the Bight, and the area has an abundance of squid, a favorite forage item. Mating occurs in the spring during migration north through the Bight waters. Observations and sightings indicate that the distribution of young whales, both calves and juveniles, resembles that of the adults; cows and calves are regularly sighted in the Bight.

The New York Bight offers an anomalous situation for this deep-water species; the Okeanos Foundation reports that they regularly see sperm whales in one location south of Montauk Point, Long Island, in less than 18 meters (59 feet) of water from late May through June and again in October. No direct observations of feeding have been made, and it is still a mystery as to what the whales are doing there, although their natural history would suggest feeding.

Minke Whales

Minke whales are a cosmopolitan species with populations scattered throughout the oceans of the world. The minke whale, *Balaenoptera acutorostrata*, is one of the smallest of the baleen whales. In the North Atlantic, at least three different stocks are recognized. Minke whales on Stellwagen Bank are part of the Canadian East Coast stock including all of the Gulf of Maine. These populations seem to be separate and genetic variability between populations may represent different species. Certainly, they are the most numerous baleen whale species at present. Minke whales are commonly observed in the waters of Massachusetts Bay and Cape Cod Bay and since 1979, sightings of this species have been routinely recorded from both commercial whale-watching vessels and dedicated surveys

Their small size and unobtrusive behavior made them unattractive to many whaling operations until other larger whale species became commercially extinct or rare. Today minkes are still hunted by a few nations including Norway and Japan.

In recent years, much has been learned about other mysticetes through long-term studies based on the identification of individual whales (see Hammond et al., 1990). Unfortunately, minke whales lack the great variability in natural markings that have facilitated detailed investigations of larger confamilials (such as humpback whales, *Megaptera novaeangliae*). This, together with the difficulty of photographing them owing to their small size and great speed, has hindered studies based on photographic identification, although studies of small localized populations have been possible (Dorsey, 1983; Dorsey et al., 1990; Stern et al., 1990). In general, however, studies of free-ranging minke whales have been few, and their population structure, social organization and migratory movements remain poorly understood.

As is the case for most baleen whales, minke whales appear to migrate to high latitudes in the summer for feeding and to travel to tropical waters in the winter for birthing (Horwood, 1989; Mitchell, 1991). However, specific breeding grounds have yet to be unequivocally identified, and it is unknown whether both sexes and all age classes in a population undertake the migration to low latitudes. In some temperate, subtropical, and tropical areas, minke whales are observed throughout the year (Ivashin and Votrogov, 1981; Best, 1982; Gong, 1987; Stern, 1990), although it is unclear whether these sightings represent year-round residency on the part of particular individuals or a more general movement through the area by members of one or more populations.

Studies of minke whales in other areas indicate that their diet may be more diverse than other local baleen whales, taking advantage of whatever is abundant in a given area or given time: copepods, krill, capelin, herring, sand lance and squid. Interestingly, the smaller minke may feed on larger food items than the larger whales do, taking fish as large as cod and pollock. Minke whales may be very flexible in their feeding strategies: chasing down small groups of large, fast swimming fish or lunging through dense patches of bait fish or zooplankton.

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APPENDIX D

Table D-1. List of Mammals at GEWA

Species	Habitat	Abundance
Viginia opossums <i>Didelphis virginiana</i>	meadow and woodland habitats	Common
Northern short-tailed shrew <i>Blarina brevicauda</i>	Meadow	Three individuals were trapped
Eastern mole <i>Scalopus aquaticus</i>	sandy soil near Pope's Creek	Possibly numerous; runs very numerous, but only a single specimen captured
Silver-haired bat <i>Lasionycteris noctivagans</i>	Mist-netted over a stream	Only one, possible during migration
Big Brown bat <i>Eptesicus fuscus</i>	Staff residence at GEWA	Unknown; Large bats seen flying at dusk on several occasions may have been this species
Eastern cottontail <i>Sylvilagus floridanus</i>	fields, meadows and early successional stage shrub-woodland habitat.	Seen on ten occasions
Southern flying squirrel <i>Glaucomys volans</i>	tree hole in a white oak.	Only one observed
Eastern gray squirrel <i>Sciurus carolinensis</i>	Staff residence and interpretive buildings where deciduous trees were common.	Commonly seen
Woodchucks <i>Marmota monax</i>	meadows and open areas along roads	Commonly seen
Meadow vole <i>Microtus pennsylvanicus</i>	Dry meadow habitat	Only one trapped
Woodland voles <i>Microtus pinetorum</i>	Dry meadow habitat	Only one trapped
White-footed mouse <i>Peromyscus leucopus</i>	buildings and in both deciduous and coniferous woodlands	Common
Common muskrats <i>Ondatra zibethicus</i>	Water and marsh of Pope's Creek	Seen on four occasions
Marsh rice rats <i>Oryzomys palustris</i>	Marshes or wet meadows	Nine individual marsh were trapped on six of 13 trap nights
American beavers <i>Castor Canadensis</i>	One observed walking on the road	Seen on three occasions; Their cuttings were seen on every visit.
The non-native house mouse <i>Mus musculus</i>	barns and out buildings where domestic animals were kept	Common
Norway rat <i>Rattus norvegicus</i>	barns and out buildings where domestic animals were kept	Common
Common gray fox <i>Urocyon cinereoargenteus</i>	crossing from a field into pine woods	Only one individual observed
Common raccoon <i>Procyon lotor</i>	cornfield when ripe corn was available.	Common
Striped skunk <i>Mephitis mephitis</i>		Only one individual observed
Mink <i>Mustela vison</i>	Tracks seen in the sand and mud along the Potomac	Unknown

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	river.	
White-tailed deer <i>Odocoileus virginianus</i>		Very common and possibly overpopulated

TableC-2. Marine Mammals Listed as Occurring off the Atlantic Coast

Common Name	Latin Name	Species occurring off Assateague Island coast (CNWR FWS Mammal Checklist)	Species occurring off Long Island, NY coast (CRESLI)	Species occurring in coastal waters of or stranded in Barnstable County, MA (MA Wildlife State Mammal List)
Northern right whale (Fed-E)	<i>Eubalaena glacialis</i>	X	X	X
Minke whale	<i>Balaenoptera acutorostrata</i>	X	X	X
Sei whale (Fed-E)	<i>Balaenoptera borealis</i>	X	X	X
Blue whale (Fed-E)	<i>Balaenoptera musculus</i>	X	X	
Fin whale (Fed-E)	<i>Balaenoptera physalus</i>	X	X	X
Humpback whale (Fed-E)	<i>Megaptera novaeangliae</i>		X	X
Common dolphin	<i>Delphinus delphis</i>	X	X	X
Long finned pilot whale	<i>Globicephala melaena</i>	X	X	X
Risso's dolphin	<i>Grampus griseus</i>	X	X	
Atlantic white-sided dolphin	<i>Lagenorhynchus acutus</i>	X	X	X
White beaked dolphin	<i>Lagenorhynchus albirostris</i>		X	X
Melon-headed whale	<i>Peponocephala acutus</i>	X		
Killer whale	<i>Orcinus orca</i>		X	X
Pantropical spotted dolphin	<i>Stenella attenuata</i>		X	
Striped dolphin	<i>Stenella coeruleoalba</i>		X	
Spotted dolphin	<i>Stenella plagiodon</i>	X		
Rough-toothed dolphin	<i>Steno bredanensis</i>	X		
Bottlenose dolphin	<i>Tursiops truncatus</i>		X	X
Pygmy sperm whale	<i>Kogia breviceps</i>	X	X	X
Beluga whale	<i>Dephinapterus leucas</i>		X	X
Harbor porpoise	<i>Phocoena phocoena</i>	X	X	X
Sperm whale	<i>Physeter catadon</i>	X	X	X

Common Name	Latin Name	Species occurring off Assateague Island coast	Species occurring off Long Island, NY coast	Species occurring in coastal waters of or stranded in Barnstable County, MA
True's beaked whale	<i>Mesoplodon mirus</i>	X		
Gervais' beaked whale	<i>Mesoplodon europaeus</i>			X (1 record only)
North Atlantic Beaked whale	<i>Hyperoodon ampullatus</i>			X (1 record only)
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	X	X	X (2 records only)
Harp seal	<i>Phoca groenlandica</i>			X
Hooded seal	<i>Cystophora cristata</i>	X	X	X
Gray seal	<i>Haliophoca grypus</i>	X	X	X
Ringed seal	<i>Phoca hispida</i>		X	
Harbor seal	<i>Phoca vitulina</i>	X	X	X

Table C-3 Stranding Networks along the Atlantic Coast

Maryland

Maryland Department of Natural Resources
Oxford Cooperative Laboratory
904 South Morris St.
Oxford, MD 21654
Hotline: (800) 628-9944

Massachusetts

Cape Cod National Seashore
Wellfleet, MA 02667
(508) 349-3785

New Jersey

Marine Mammal Stranding Center
PO Box 773
Brigantine, NJ 08203
(609) 266-0538

New York

Riverhead Foundation for Marine Research
431 East Main St.
Riverhead, NY 11901
Hotline: 631-369-9829

Virginia

Virginia Marine Science Museum
717 General Booth Blvd.
Virginia Beach, VA 23451
Hotline: (757) 437-6159
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, VA 23062
Hotline: (804) 684-7313

Chapter V. Fish

Section I. Introduction

The nation's living marine resources provide significant social and economic benefits. The sale of domestically caught fish and shellfish by commercial fishers currently exceeds \$3.5 billion, making the U.S. the fifth-largest producer of seafood in the world. In 2000 alone, U.S. consumers spent an estimated \$54.4 billion for fishery products. By producing and marketing a variety of fishery products for domestic and foreign markets, the commercial marine fishing industry contributed \$27.8 billion (in value added) to the U.S. Gross National Product (GNP). Likewise, recreational fishers and marine recreational fishing activities contribute almost an equal amount to the nation's GNP.

Section II. National Fishery Regulatory Agencies

National Oceanic and Atmospheric Administration/ National Marine Fisheries Service

The National Oceanic and Atmospheric Administration (NOAA) conducts research and gathers data about the global oceans, atmosphere, space and sun. NOAA warns of dangerous weather, charts the seas and skies, guides our use and protection of ocean and coastal resources, and conducts research to improve our understanding and stewardship of the environment which sustains us all.

As a Commerce Department agency, NOAA provides these services through five major organizations: the National Weather Service, the National Ocean Service, the National Environmental Satellite, Data and Information Service, the National Marine Fisheries Service (NMFS), NOAA Research; and numerous special program units.

NMFS works to promote sustainable fisheries and to prevent lost economic potential associated with overfishing, declining species and degraded habitats. Through its many actions, programs and research, NMFS ensures the continued productivity and abundance of the nation's living marine resources. This public trust responsibility is derived from numerous laws, primary of which are the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA), which were passed in the mid/late 1970s. The last few years have seen several profound legal and conceptual changes in the management landscape of the nation's marine fisheries—notably, major revisions to the the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).

The MSFCMA provides a wide array of protections, requiring very conservative management targets, tight time frames for rebuilding stocks, consideration of habitat impacts, reducing bycatch and assessing economic impacts on fishing communities. In 1996 Congress added new habitat conservation provisions to the MSFCMA. These provisions mandated the identification of Essential Fish Habitat (EFH) for managed species as well as measures to conserve and enhance the habitat necessary to fish to carry out their life cycles. Congress defined EFH as

“those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 U.S.C. 1802(10)) and state agencies, and others in achieving EFH protection, conservation, and enhancement.

In addition, the provisions require NMFS to minimize damage to EFH from fishing practices, to the extent practicable. Additionally, it requires Federal agencies that authorize, fund, or conduct activities that “may adversely affect” EFH to work with NMFS to develop measures that minimize damage to EFH. For example, agencies proposing to dredge or fill habitats in or near EFH, must consult with NMFS to develop EFH conservation measures if the action may adversely affect EFH. While NMFS does not have veto authority over federal projects adversely affecting EFH, this mandate enables NMFS to provide guidance to Federal action agencies on ways to tailor their projects to minimize harm to EFH.

The NMFS New England and Mid-Atlantic Fishery Management Councils are responsible for management of fisheries in federal waters that occur predominantly off the New England and Mid-Atlantic coast respectively. The Northeast Fisheries Science Center compiled the available information on the distribution, abundance and habitat requirements for each of the species managed by the New England and Mid-Atlantic Fishery management Councils. That information is presented in a series of 30 EFH species reports. The EFH species reports comprise a survey of the important literature as well as original analyses of fishery-independent data sets from NMFS and several coastal states. The species reports are also the source for the current EFH designations by the New England and Mid-Atlantic Fishery management Councils and are referred to as the “EFH source documents”. For species reports on the New England and Mid-Atlantic Fisheries online go to: <http://www.nefsc.noaa.gov/nefsc/habitat/efh/> or Search NOAA’s Fisheries at: <http://www.nefsc.noaa.gov/search.html/>

The NMFS Office of Protected Resources (OPR) handles the listing, protection and recovery of threatened and endangered marine, estuarine and anadromous species under the Endangered Species Act (ESA). The ESA requires federal agencies to use all reasonable methods available to conserve endangered and threatened species, to facilitate an increase in their populations and to improve the quality of their habitats. OPR serves as the principal liaison for NMFS with environmental organizations, industry, other Federal and state agencies, the academic community and works with the NMFS Regions and Fisheries Science Centers on the conservation and recovery of species listed under the ESA.

For more information contact NOAA Fisheries public affairs at (301) 713-2370 or go online to: <http://www.nmfs.noaa.gov/>

The U.S. Fish and Wildlife Service implements programs and regulations for freshwater fish species under the ESA.

Section III. Status of Atlantic Coast Fisheries

Introduction

The shallow waters of Maryland's coastal bays have historically supported large populations of juvenile finfish and shellfish; adults of many species of fish are also seasonally common. Atlantic croaker, bluefish, spot, summer flounder, weakfish, and shark are important both recreational and commercial species which use habitats of the coastal bays. Over 115 species of finfish, 17 species of mollusks, 23 species of crustaceans and countless foraging/grazing organisms frequent these bays.

The richness of fish species in the New York Bight is due to a unique situation. The area is a transition zone where the northern cold water (boreal) species and the warm water (temperate) fauna meet, with both groups at the limits of their respective ranges. There are a few endemic fish species in the Bight; however, the majority are seasonal migrants, taking advantage of the opportunity to use the area for reproduction and/or growth. The vastness of the relatively shallow continental shelf area and the number of high-quality estuary systems that nurture and protect estuarine-dependent fish are major contributing factors to this area's diversity and regionally-significant secondary production.

Estuarine Fishes

There are a number of resident estuarine fishes whose entire existence depends on the shallow water habitats provided by the backbarrier lagoons, tidal rivers, and creeks of the area. These fish form an important forage base for larger predatory fish and piscivorous birds. Examples of this group include Atlantic silverside (*Menidia menidia*), mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), sheepshead minnow (*Cyprinodon variegatus*), bay anchovy (*Anchoa mitchilli*), three-spined stickleback (*Gasterosteus aculeatus*), and four-spined stickleback (*Apeltes quadracus*); all life stages of these species can be found in the estuary system throughout the year. American eel (*Anguilla rostrata*), a catadromous fish, uses the estuaries and freshwater areas as its residence except when it migrates to sea to reproduce. There are many estuarine migratory species the estuary primarily as a nursery area, and or as a forage area for juveniles or adults. Winter flounder (*Pleuronectes americanus*), tautog (*Tautoga onitis*), black sea bass (*Centropristis striata*), Atlantic menhaden (*Brevoortia tyrannus*), bluefish (*Pomatomus saltatrix*), mullet (*Mugil* ssp.), sandlance (*Ammodytes americanus*), bay anchovy, and striped bass (*Morone saxatilis*) are prevalent species on the east coast that use the backbarrier lagoons, large tidal rivers, and tidal creeks for spawning or nurseries. These fish tend to migrate in and out of the system on a seasonal basis. The anadromous component of this group annually migrates into the freshwater areas to spawn. Winter flounder and sandlance spawn in the estuarine zone. Bay and ocean spawners such as bay anchovy, sea bass, bluefish, tautog, and menhaden have larval and early juvenile stages that will drift toward or swim shoreward to seek out the nutrient-rich, food-abundant, estuarine area where, during the warmer months, they have the greatest opportunity to grow. The nearshore and shallow water habitats are the most vulnerable aquatic habitats in this system because of the anthropogenic influences and insults to them, plus overuse by an expanding human population that values these areas for development and recreation.

Anadromous fishes

Acipenseridae (sturgeons)

Sturgeon are long-lived, slow growing species that have suffered serious historical declines because of their value as a high-quality food fish and an important source of caviar. The Atlantic sturgeon is protected over much of its range through fisheries management efforts, and the shortnose sturgeon is listed federally as an endangered species. Sturgeon use large rivers and estuaries almost exclusively during the first five years of their lives. Both species begin their spawning migration in late winter to early summer, with the shortnose starting earlier than the Atlantic. Sturgeons mature late in life; males at 8 to 12 years and females at 12 to 15 years. It is not known how long on average sturgeon live, but they are assumed to be long-lived. Shortnose sturgeon retreat to the deep freshwater upriver areas in winter, but Atlantic sturgeon behavior is not as clearly defined. Atlantic sturgeon are known to make oceanic migrations of considerable distances both north and south, but this remains poorly documented for the rarer shortnose sturgeon.

Clupeidae (herrings)

Along the Northeast coast, true herrings are represented by alewife and blueback, collectively called river herrings; American shad; the less common hickory shad and gizzard shad; and two marine non-anadromous species, Atlantic menhaden and Atlantic herring. The herring family dominant biomass components in marine and freshwater systems. The true anadromous fish, however, have all undergone reduced populations because of common problems of overharvesting, pollution, and the restriction of freshwater spawning habitat areas, principally through dams and other obstructions of fish passage.

Moronidae (temperate river basses)

The two temperate river bass of the Bight region share a number of physical and morphological similarities and are difficult to tell apart during their early life stages. The striped bass is strongly anadromous and highly migratory, while the white perch is more or less restricted to estuarine waters and seldom found in open marine waters.

Osmeridae (smelts)

On the east coast, rainbow smelt is an abundant forage fish that is regularly preyed upon by top predator coastal marine species, especially striped bass and bluefish. In the early spring, smelt migrate into the coastal streams above the head of tide to spawn. After hatching, larvae are transported to the estuary area where they feed and grow. Smelt rarely move out of the nearshore coastal area, straying no more than 2 kilometers (1.2 miles) from shore to a maximum depth of 6 meters (19.6 feet).

Petromyzontidae (lampreys)

The sea lamprey is a parasitic anadromous fish that spends its egg and larval life stages entirely in fresh water. At transformation (the process by which the lamprey's body changes into that of a parasite), it moves out to sea for its parasitic life phase during which it lives on a host fish. After one to two years at sea, it returns to fresh water as an adult to spawn and then dies. Because of the economic importance and the profound effects of the sea lamprey on fish communities, its life history has been studied intensely.

Salmonidae (trout)

The brown trout is a non-native, introduced anadromous species, of which some sea-run strains are found in a few locations on Long Island in the Bight study area. The anadromous form of brook trout, a closely related species, is found in some of the adjacent New England waters.

Anguillidae (freshwater eels)

American eel adults and various life stages are found in oceanic, coastal, and freshwater environments from the southern tip of Greenland and Labrador south, covering the entire Atlantic coast and most of the Gulf coast of North America. American eels are marketed for human consumption and as bait for various recreational and commercial fisheries. Adult eels are commercially caught for the European smoked eel markets and juvenile elvers (immature eels) are harvested for Japanese aquaculture. The eel is an important food item of larger marine and freshwater fishes and is a predator on species such as crabs and clams. Eels have a propensity for working their way upstream over or around small obstructions, sometimes traveling overland on rainy nights. Eels spend considerable time buried in the substrate (gravel or mud) or under rocks. Recent studies indicate that eels suffer substantial losses while migrating upstream because of dams and other obstructions, while on their journey downstream losses occur as eels collide with turbines. Several studies are underway to determine solutions to these problems.

Atlantic Sharks

There is concern for the declining populations of sharks, since they are slow-growing and long-lived species with slow reproductive rates. Although the three groups, pelagic, large coastal, and small coastal, are managed under a fisheries management plan, there is a critical lack of data necessary to address shark harvest rates and reproductive capacity.

Some sharks found along the east coast include: Pelagic and coastal sharks that are sought by commercial and recreational anglers. **Pelagic sharks** include blue shark (*Prionace glauca*), thresher shark (*Alopias vulpinus*), bigeye thresher (*Alopias superciliosus*), oceanic whitetip shark (*Carcharhinus longimanus*), sixgill shark (*Hexanchus griseus*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), and longfin mako (*Isurus paucus*). **Large coastal sharks** include dusky shark (*Carcharhinus obscurus*), reef shark (*Carcharhinus perezi*), blacktip shark (*Carcharhinus limbatus*), spinner shark (*Carcharhinus bevipinna*), silky shark (*Carcharhinus falciformis*), bull shark (*Carcharhinus leucas*), night shark (*Carcharhinus signatus*), basking shark (*Cetorhinus maximus*), tiger shark (*Galeocerdo cuvier*), lemon shark (*Negaprion brevirostris*), whale shark (*Rhincodon typus*), scalloped hammerhead (*Sphyrna lewini*), great hammerhead (*Sphyrna mokarran*), smooth hammerhead (*Sphyrna zygaena*), sandbar shark (*Carcharhinus plumbeus*), and great white shark (*Carcharodon carcharias*). **Small coastal sharks** include finetooth shark (*Carcharhinus isodon*), blacknose shark (*Carcharhinus acronotus*), Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), bonnethead shark (*Sphyrna tiburo*), and Atlantic angel shark (*Squatina dumeril*).

Demersal or Groundfish Fisheries

The principal groundfish and flounders that are intensively sought for their food value are winter flounder (*Pleuronectes americanus*), summer flounder (*Paralichthys dentatus*), witch flounder (*Glyptocephalus cynoglossus*), windowpane flounder (*Scophthalmus aquosus*), silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and yellowtail flounder (*Pleuronectes ferrugineus*).

Other fish caught in the northeast include Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), pollock (*Pollachius virens*), white hake (*Urophycis tenuis*), goosefish (*Lophius americanus*), ocean pout (*Macrozoarces americanus*), scup (*Stenotomus chrysops*), tilefish (*Lopholatilus chamaeleonticeps*), black sea bass (*Centropristis striata*), spot (*Leiostomas xanthurus*), weakfish (*Cynoscion regalis*), and spiny dogfish (*Squalus acanthias*).

Pelagic fish: Bluefish and mackerel are prized recreational species. Also fished in the pelagic zone are two species of invertebrates, long-finned and short-finned squid (*Loligo pealeii* and *Illex illecebrosus*). The herring and mackerel fisheries have rebounded from minimal levels in the mid-1970s to a recovered status. In an interesting biomass shift, the American sandlance, an opportunistic species whose populations exploded with the 1970's decline of its major predators, herring and mackerel, is now itself declining.

Highly Migratory Pelagic fish: Major species of these wide-ranging pelagic species found along the east coast include Atlantic swordfish (*Xiphias gladius*), sailfish (*Istiophorus platypterus*), blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), Atlantic bluefin tuna (*Thunnus thynnus*), albacore (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), blackfin tuna (*Thunnus atlanticus*), yellowfin tuna (*Thunnus albacares*), little tunny (*Euthynnus alletteratus*), skipjack tuna (*Katsuwonus pelamis*), bullet mackerel (*Auxis rochei*), and frigate mackerel (*Auxis thazard*).

Coastal Migratory Pelagic Fisheries

These fast-swimming schooling fishes range from the shore to the continental shelf edge along the east coast and are sought by both recreational and commercial anglers. Included in this assemblage are king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), and dolphin fish (*Coryphaena hippurus*). They share the common characteristics of rapid growth, voracious feeding, and high reproductive capacity, as they mature at an early age and spawn over protracted periods of time. These fish utilize the highly productive coastal waters during the summer months and migrate to deeper and/or distant waters during the rest of the year.

Freshwater Fishes

Loss of important aquatic habitat by anthropogenic pollution is the primary threat to freshwater fish, and their survival depends on curbing point and nonpoint source pollution, managing for the prevention of accidental chemical and oil spills, and reducing atmospheric pollutants in the environment. Many of these species are sought after in freshwater sportfisheries and are managed by fishing regulations set by the respective states.

Other species of note

Although not truly an anadromous species, the tomcod (*Microgadus tomcod*), an inshore coastal fish, moves upstream into brackish waters to spawn. They are fast-growing and short-lived, seldom living past their second year. Because of their short life span and abundance in estuarine systems, as well as their sensitivity to environmental stresses, tomcod numbers serve as an excellent measure of environmental health.

The bay anchovy (*Anchoa mitchilli*) is a small, delicate, estuarine-spawning, schooling fish that is abundant in the mid-Atlantic region. Bay anchovy is an important prey item for striped bass, bluefish, weakfish, white perch, and many piscivorous birds. Spawning occurs over an extended period from May to September with water temperatures ranging from 15 to 30°C (59 to 86°F). Bay anchovy are often the dominant species in the Hudson River estuary and are well-suited to the area since they are planktonic feeders; detritus from sewage supplements their main food source.

Section II. National Monitoring Programs

NMFS Monitoring and Research

NMFS conducts its stewardship responsibilities through a wide range of scientific research, fisheries management, protected species, and enforcement and habitat conservation programs. Using the tools provided by the Magnuson-Stevens Act, NMFS assesses and predicts the status of fish stocks and ensures compliance with fisheries regulations.

Field offices of NMFS, with the cooperation of coastal states, collect and compile data on U.S. commercial landings. The NMFS Fisheries Statistics and Economics Division in Silver Spring, MD, manages the collection and compilation of recreational statistics, in cooperation with various States and Interstate Fisheries Commissions, and tabulates and prepares all data for publication. For data sets and publications relating to this data go to:

<http://www.nmfs.noaa.gov/publications.htm/>

OPR develops, implements, and administers programs for the protection, conservation, and recovery of federally protected species. Additionally, it establishes cooperative agreements with states regarding listed species management and protection and identifies endangered species research needs to collect appropriate information for management decisions.

EPA Coastal 2000/EMAP

Coastal 2000 and the Environmental Monitoring and Assessment Program (EMAP) are national research programs led by the Environmental Protection Agency's Office of Research and Development (EPA-ORD). Coastal 2000/EMAP are intended to develop the scientific tools and agency partnerships needed to broadly assess the status and trends of significant ecological systems. The goal of EMAP is to "monitor the condition of the Nation's ecological resources to evaluate the cumulative success of current policies and programs and to identify emerging problems before they become widespread or irreversible" (EPA 1997). This program will provide an estimate of the condition of significant estuarine and coastal resources. It is also intended to build the partnerships and provide the tools needed to address resource issues of regional and state interest.

Northeast Fisheries Science Center

The Fisheries Independent Surveys Group of the Northeast Fisheries Science Center conducts surveys that provide consistent, unbiased estimates of relative abundance for many of the finfish and shellfish species in the Northeast region. In addition to tracking abundance of mature animals, research surveys provide indices of juvenile abundance, which can indicate strong year classes before fish are vulnerable to commercial or recreational fisheries. Research surveys indicate the status of a stock over the entire range of its distribution, not just in small areas of commercial or recreational concentration. Surveys also provide data to monitor the processes of growth, maturity, predation, and mortality of a stock as well as trophic dynamics of fish communities. Data collected in these programs are archived into computer data files that are vital for assessment, management and a wide variety of research programs. Surveys are also

used to collect some of the information for the Ecosystem Monitoring Group of the Northeast Fisheries Science Center.

The Ecosystems Monitoring Group conducts surveys designed to monitor and assess changes in the biological productivity and physical properties of the northeastern U.S. continental shelf waters. The long-range goal of the Ecosystem Monitoring Group is to produce and disseminate reliable assessments of the changing states of the Northeast Shelf ecosystem in relation to the natural productivity of the ecosystem and the effects of ecosystem changes on fisheries productivity.

The various types of surveys conducted by the Northeast Fisheries Science Center are described below:

Spring and autumn bottom trawl survey

The spring and autumn bottom trawl surveys conducted by the Northeast Fisheries Science Center are the longest running continuous time series of research vessel sampling in the world. The autumn survey was initiated in 1963; the spring in 1968 (Azarovitz 1981). These surveys cover the ocean environment from 5 to 200 fathoms deep, from Cape Hatteras, North Carolina to well beyond the Canadian boarder. About 300 half-hour trawl sets are made at sites ("stations") randomly chosen using a stratified-random" sampling design. The objective of each tow is not to catch large numbers of fish, but a representative sample of the various species and relative numbers in a given area.

The accumulated trawl survey data set (1963 to present) represents over 20,000 stations, with millions of individual pieces of information concerning fishery resources of the region. The entire data series is available to fishery scientists wishing to examine trends in abundance, distribution, species associations, or numerous other scientific questions.

Winter trawl survey along the continental shelf

Initiated in 1992, a winter trawl survey along the Middle Atlantic, Southern New England and southern Georges Bank continental shelves is specifically directed to improve the quality of flatfish assessments. The new survey employs a chain sweep (a "flat net") to minimize the escapement of flatfish under the foot rope. Accordingly, abundance indices from the new survey are likely to provide a more accurate assessment tool than that derived from roller-rigged gear. Specifically, the survey has been used to improve assessments for summer flounder. Assessments of other species caught along with these two important flatfish have also be improved.

Surveys of fish eggs and larvae

Surveys of the distribution and abundance of free-floating eggs and larvae are conducted several times per year to evaluate the timing and distribution of spawning. Another important function of these surveys is to estimate the quantity of larvae spawned, and thereby work back to the size of the female population that must have been present to produce the numbers of small fish counted. This "back-calculation" of the spawning stock is an important tool used in assessing fish populations worldwide, and in some cases may be the only reliable information about the size of the spawning stock. Samples are preserved at sea for later intensive analysis in the laboratory. These fine-mesh plankton nets also sample the community of free-floating plants and animals that support

the base of marine food chains. These animals are also assessed to examine the production and distribution of zooplankton (animals) and phytoplankton (plants).

National Centers for Coastal Ocean Science

The National Centers for Coastal Ocean Science (NCCOS) conducts and supports monitoring, research, assessment, and assistance for the range of NOAA's coastal stewardship responsibilities. Formed within the National Ocean Service in March 1999, it puts all NOAA's coastal research centers in one group. Each Center has specific capabilities and research expertise in important ocean and coastal issues.

The Center for Sponsored Coastal Ocean Research

(<http://www.nccos.noaa.gov/about/cscor.html>)

The Center for Coastal Monitoring and Assessment

(<http://www.nccos.noaa.gov/about/ccma.html>)

The Center for Coastal Fisheries and Habitat Research

(<http://www.nccos.noaa.gov/about/ccfhr.html>)

The Center for Coastal Environmental Health and Biomolecular Research

(<http://www.nccos.noaa.gov/about/ccehbr.html>)

The Hollings Marine Laboratory

(<http://www.nccos.noaa.gov/about/hml.html>)

NCCOS activities focus on five key areas of ecosystem stress: climate change, extreme natural events, pollution, invasive species, and land and resource use. At this time, these are being studied in four ecosystems: estuaries, coral reefs, National Marine Sanctuaries, and National Estuarine Research Reserves. Understanding how these stressors affect ecosystems is vital for assessing the impacts on coastal communities and effectively managing our Nation's ocean and coastal resources.

NCCOS evaluates environmental, societal, and economic issues through Integrated Assessments. The Assessments describe the ecosystem and its condition, forecast future ecological health, and evaluate management strategies and their consequences. They provide focused, relevant, and timely science that managers can use to make better decisions.

The scientists within NCCOS conduct applied research and manage complex long-term research projects. The projects provide a link between research science in academia and the needs of those who make decisions on use of coastal and marine areas. NCCOS scientists integrate research across scientific disciplines to examine future scenarios of coastal ecosystem conditions. Driven by NOAA's mandates in content and in timing, the science conducted and supported by NCCOS focuses on applicability to agency and constituents' needs for practical answers.

NCCOS capabilities include the ability to respond rapidly to unexpected agency needs and to make recommendations with less than 'perfect' knowledge. Depending on the type of research, results may be available immediately, in 3-5 years, or in a few cases, a decade. In all cases, however, the research is focused on distinct problems that, if solved, will help NOAA carry out its responsibilities.

Since it is impossible to predict the results of any research, NCCOS builds flexibility into its research planning to develop and explore unanticipated results when planning future projects. This maintains a balance between basic and applied research within a management agency and provides the capability to anticipate future environmental issues and technologies.

The focus of NCCOS is to provide useful and valuable scientific information and services through the conduct and support of research to further the NOAA environmental and economic missions.

The Center for Coastal Fisheries and Habitat Research

The Center provides managers with information needed to enhance recreational and commercial fishing and Essential Fish Habitat information required under the Magnuson-Stevens Fishery Management and Conservation Act. Jointly sponsored by the National Ocean Service and National Marine Fisheries Service, the CCFHR conducts laboratory and field research on estuarine processes, nearshore and ocean ecosystems biological productivity, the dynamics of coastal and reef fishery resources, and the effects of human influences on resource productivity.

Coastal Habitats - Research focuses on the importance of coastal and estuarine habitats to fish, the impacts of natural and human factors on these habitats, and how to restore them. Current studies include salt marshes, intertidal flats, and seagrasses along the Atlantic and Gulf coasts and large California coastal bays. The Center also conducts studies on micro-algae, seagrass and salt marsh plants, invertebrates and fishes, bacterial interactions, and the linkages between habitats and all fishery organisms.

Population Dynamics - Valuable commercial and recreational fish in the Atlantic and Gulf of Mexico are monitored to gather accurate population data. Data and statistics are provided to the Atlantic/Gulf of Mexico Fishery Management Councils and the National Marine Fisheries Service for their decisions. The Center also assists other institutions with fish assessments as requested.

Protected Species - The Endangered Species Act and Marine Mammal Protection Act require monitoring of protected sea turtles and marine mammals. Information gathered includes overall characteristics (e.g., age, sex) genetic structure, habitat requirements, and navigational cues. Also assessed are impacts of fish interactions.

The Center for Coastal Monitoring and Assessment

The Center for Coastal Monitoring and Assessment monitors, surveys, and assesses coastal environmental quality, habitats, and resource distribution. The Center manages the National Status and Trends Program that conducts long-term contaminant monitoring at more than 350 estuarine and coastal sites. Information from the Center's monitoring programs are synthesized and evaluated to determine the impacts of contaminant exposure and changes in coastal habitats on the distribution and abundance of living marine resource.

Coastal Characterization and Assessment - The Biogeography Program is developing a knowledge base of living marine resource distributions and ecology in estuarine and coastal environments. It provides scientists and resource managers with the information needed for

better management of coastal resources. The Program integrates information on species, habitats, and the strength of species-habitat affinities using technologies such as Geographic Information Systems (GIS) and modeling. Scientists also analyze physical and hydrological features of estuaries and coasts to understand the impact of freshwater inflow, salinity, and nutrient inputs on the health of estuarine and coastal waters.

Coastal Ecosystem Monitoring - These long-term projects under the National Status and Trends Program monitor and document U.S. coastal environmental quality. Activities include assessing the relationship between contaminated sediments and toxicity in fish, historical analysis of sediment contamination, and determining impacts of natural and human stresses on coastal resources. Additionally, researchers in the Mussel Watch Project periodically collect surface sediment and annually collect mussels and oysters at sites around the Nation. Comparison of contaminant concentrations determines which coastal regions are at greatest risk. (See National Status and Trends Program below)

Remote Sensing - The Remote Sensing Development Program assesses estuarine and coastal environmental problems. While emphasis is on standard sensors, particularly satellites, researchers also develop and use new techniques to monitor coastal water quality, track harmful algal blooms, and assess coastal habitat changes. These are integrated with field and instrument observations. With these data, resource managers can respond rapidly to conditions which may be impacting coastal habitats and marine resources.

For more information go online to: <http://www.nccos.noaa.gov/>

National Status and Trends (NS&T) Program

In 1984, NOAA initiated the National Status and Trends (NS&T) Program to determine the current status of, and to detect changes in, the environmental quality of our Nation's estuarine and coastal waters. The NS&T Program is managed by the Center for Coastal Monitoring and Assessment (CCMA) in NOAA's National Ocean Service. The NS&T (1) conducts long-term monitoring of contaminants (Table 1) and other environmental conditions at more than 350 sites along U.S. coasts, (2) studies biotic effects intensively at more than 25 coastal ecosystems, (3) partners with other agencies in a variety of environmental activities, and (4) advises and participates in local, regional, national, and inter-national projects related to coastal monitoring and assessment.

The NS&T Program is comprised of several projects. These are: Benthic Surveillance Project, the Mussel Watch Project, the Quality Assurance Project, Historic Trends, the Sediment Coring Project, the Specimen Banking Project, Sediment Toxicity Surveys, Biomarkers, Environmental Indices, and Regional assessment and topical reports.

National Benthic Surveillance Project

From 1984 through 1993, the National Benthic Surveillance Project (NBSP) monitored chemical concentrations in the livers (and for metabolites of PAH's in the bile) of bottom-dwelling fish and in sediments at the sites of fish capture. The NBSP also measured the biological effects of contaminant exposure, primarily as prevalences of toxicopathic liver diseases, such as neoplasms (tumors), preneoplasms and other diseases involved in the process of liver neoplasia. Using site

selection criteria similar to those used for the Mussel Watch Project, the NBSP monitored contaminant exposure and bioeffects at more than 120 sites nationwide. This was a cooperative effort with NMFS Northwest, Southeast, and Northeast Fisheries Science Centers. Sites applicable to the C&B Network include Lloyds Point, Long Island, NY (SAHI); Raritan Bay (GATE-Sandy Hook Unit); York River (COLO). Also a summary report of Status and Trends of Contaminant Levels in Biota and Sediments of the Chesapeake Bay is available at: <http://ccmaserver.nos.noaa.gov/NSandT/CB.html/>

Analyses of the NBSP data have shown strong correlations between levels of most contaminants, except for several heavy metals, in fish livers and in sediments at the sites of capture. After accounting for the risk associated with age, Benthic Surveillance scientists also found the risk of toxicopathic liver disease significantly increased in fish collected from moderately to heavily contaminated areas. The chemical contaminants most frequently identified as risk factors associated with disease include high molecular weight polycyclic aromatic hydrocarbons (PAHs), DDTs, PCBs, chlordane, and dieldrin. Prevalences of several different types of liver lesions begin to increase at sediment concentrations of total PAHs below one part per million. For more information regarding this project go online to: <http://ccmaserver.nos.noaa.gov/NSandT/NS%26TBS.html/>

NS&T Mussel Watch Project

Since 1986, NS&T's Mussel Watch has monitored chemical contaminants in sediments and bivalve mollusks (e.g., mussels and oysters). Mussel Watch sites are selected to be representative of large coastal areas and to avoid small-scale patches of contamination, or "hot spots." For this reason, its data can be used to compare contaminant concentrations across space and time to determine which coastal regions are at greatest risk in terms of environmental quality. Presently, bivalves are collected every other year and sediments about every fifth year at a network of over 250 U.S. coastal and estuarine sites. Tissue contaminant concentrations are measured for several different bivalve species. Bivalve and sediment samples are collected from three stations at each site (stations are generally within 100 m of a site center). Bivalves are dredged or hand collected in intertidal to shallow subtidal zones.

When first establishing its monitoring network, NS&T Mussel Watch Project based its suite of measured contaminants on an earlier EPA Mussel Watch Program and reoccupied 50 sites from that Program. Using statistical techniques to compare the data sets from these two programs (1976-78 and 1986-88), a decrease in lead (Pb) concentrations was evident in molluscan tissues over the intervening ten years, while copper (Cu) concentrations were found to have increased. The decrease in Pb was attributed to phasing out of alkyl-lead in gasoline in the United States, while the increase in Cu was attributed to increased U.S. usage.

Sites applicable to the C&B Network include Fire Island Inlet and Moriches Bay (FIIS); Jamaica Bay and Sandy Hook (GATE); Potomac River (near GEWA); and Chincoteague Inlet (ASIS).

For more information on the Mussel Watch Project go online to:

<http://ccmaserver.nos.noaa.gov/NSandT/NS%26TMW.html/>

NS&T Specimen Banking Project

Some of the NS&T sediment and tissue samples are retained for possible retrospective analyses using improved analytical techniques or for chemicals newly recognized to be of environmental

concern. Coastal and marine environments certainly contain chemical contaminants that have not yet been recognized as a threat. When such chemicals are discovered, it would be invaluable to know their concentration and distribution in previous years. It is also possible that the chemicals being quantified today will be analyzed differently in the future (e.g., today's methods of PCB analysis are very different from those used fifteen years ago). Because of these possibilities, the NS&T Program is building and maintaining a specimen bank at NIST. For more information regarding this Project go online to: <http://ccmaserver.nos.noaa.gov/NSandT/NS%26TBank.html>.

NOAA's Environmental Technology Lab

ETL researchers collaborate with colleagues around the world to create advanced remote sensors to address environmental measurement challenges. Remote sensors use light, radio, and sound waves to observe distant ocean properties and processes. Ocean remote sensors can provide information vital to improved fisheries management.

Instruments developed at ETL show promise for helping fisheries managers monitor fish stocks and track sea surface currents which influence the health of the coast zone. Fish lidar has been flown for a number of population surveys in conjunction with conventional sampling techniques. As an operational instrument, fish lidar could allow scientists to conduct more accurate surveys over larger areas at lower cost. *For more information contact:* Environmental Technology Laboratory; 325 Broadway R/E/ETBoulder, Colorado 80303; email info@etl.noaa.gov or go online to: <http://www.etl.noaa.gov>

Watershed Restoration Action Strategy (WRAS)

The Clean Water Action Plan is a Federal initiative with the intent to guide all states in their renewed efforts to restore and protect their water resources. The Clean Water Action Plan (CWAP) required states to: 1) develop a unified watershed assessment (UWA) to assess the condition of their watersheds; 2) set watershed restoration priorities based on the UWA (i.e., selecting those watersheds not meeting clean water and other natural resource goals that are most in need of restoration actions); and, 3) develop watershed restoration action strategies (WRASs) that identify the most important causes of water pollution and resource degradation and detail the actions needed to address these problems, and set milestones by which to measure progress.

The REEF Environmental Education Foundation

REEF was founded in 1990, out of growing concern about the health of the marine environment, and the desire to provide the SCUBA diving community a way to contribute to the understanding and protection of marine populations. REEF achieves this goal primarily through its volunteer fish monitoring program, the REEF Fish Survey Project. Participants in the Project not only learn about the environment they are diving in, but they also produce valuable information. Scientists, marine park staff, and the general public use the data that are collected by REEF volunteers.

REEF's mission, to educate and enlist divers in the conservation of marine habitats, is accomplished primarily through its Fish Survey Project. The Project was developed in 1990 with support from The Nature Conservancy (TNC) and guidance by the Southeast Fisheries Science Center of the National Marine Fisheries Service (NMFS). The REEF Fish Survey Project allows volunteer SCUBA divers and snorkelers to collect and report information on marine fish populations. The data are collected using a fun and easy standardized method, and are housed in a publicly-accessible database on REEF's Website. These data are used by a variety of resource agencies and researchers.

As the REEF Fish Survey Project has grown, several papers and products have been produced using the roving diver survey method and the REEF database. In addition, the REEF Fish Survey Project has become integrated into several projects. These collaborations have included those with management agencies and other non-profit organizations.

While the main focus of REEF's program is marine fish, additional components are incorporated through collaborations with other organizations – the Living Reef project which is a Pacific Northwest Invertebrate monitoring program and the Sea Turtle Sighting Program. For more information go to: <http://www.reef.org/index.shtml/>

Army Corp of Engineers

The Army Corp of Engineers is involved with three large feasibility studies for areas encompassing both GATE and FIIS. To find out more regarding these studies go online to: <http://www.nan.usace.army.mil/project/newyork/nyeco.htm/>

National Sea Grant Program

To make the most of their promise while providing for their protection, the National Sea Grant Program encourages the wise stewardship of our marine resources through research, education, outreach and technology transfer. Sea Grant is a partnership between the nation's universities and National Oceanic and Atmospheric Administration (NOAA) that began in 1966, when the U.S. Congress passed the National Sea Grant College Program Act

Although the Sea Grant Colleges are focused on marine research and the sustainable development of marine resources. These groups provide good links to current research and associated scientists.

The Northeast Region of Sea Grant includes those programs in Maine, New York, and Massachusetts. The Mid-Atlantic region is a gateway to the five Sea Grant programs in the coastal and near-coastal waters between New Jersey and North Carolina. For more information regarding these research programs go to:

<http://www.nsgo.seagrant.org/NationalSeaGrant.html#NE>

Section IV. State Monitoring Programs

NYDEC: The Bureau of Marine Resources

205 North Belle Mead Road, Suite 1 East Setauket, New York 11733

The Bureau of Marine Resources is responsible for the management of living marine resources and their habitats within the Marine and Coastal District of New York State. The Bureau is divided into three major program areas which deal with finfish and crustaceans, shellfish, and marine habitat protection. The principal responsibilities of each program area are described below.

Finfish and Crustaceans

This program monitors and develops management recommendations for the principal finfish and crustacean species of the State. These include striped bass, shad, sturgeon, weakfish, winter flounder, scup, blackfish, bluefish, fluke, lobster, blue crab, horseshoe crab, and many others. Because nearly all these species migrate up and down the coast and occur in the waters of several states, data collection and management responsibility is shared among states and between the states and federal government. Two of the principal institutions for accomplishing this cooperative management are the Atlantic States Marine Fisheries Commission and the Mid-Atlantic Fishery Management Council. Each of these institutions has representatives from New York State who help make the management decisions.

Program staff also directly sample fish populations through a series of seine surveys and trawl surveys in the western bays and on the southern shores of Long Island, and Peconic bays. The program also conducts a series of surveys of recreational and commercial fisheries to collect data for species management. In addition, the program has ongoing projects which deal with public access to the marine waters and the development of artificial reefs.

Shellfisheries-The Shellfish Section has two program units: shellfish resource management and shellfish sanitation. The management unit is responsible for the maintenance of the State's bivalve mollusk resource. Management plans are developed and implemented for the harvest of specific shellfish species. The Shellfish program also oversees the shellfish transplant program and mariculture.

Bivalve mollusks are filter feeders and may concentrate bacteria and viruses in their bodies if exposed to these pathogens in contaminated waters. Consequently, the shellfish sanitation program exercises sanitary control of the harvest, handling and processing of shellfish to provide adequate public health protection for the shellfish consumer. Water quality monitoring is conducted in the State's shellfish growing areas. Areas with unacceptable bacteria levels are closed to shellfish harvesting. Shellfish inspectors regularly inspect shellfish processing and wholesale shellfish dealers' facilities to ensure that they are in compliance with federal and state requirements.

Marine Habitat Protection-This program administers the state's Tidal Wetland Act which involves the review of proposed activities which may impact tidal wetlands. This may include construction of buildings, dredging, and filling activities. This program also administers the State's Protection of Waters and federal Clean Water Act Section 401 Water Quality Certification permit programs. This typically involves dredging and filling activities (including dredged material disposal) within the wetlands and marine waters of the state. Marine Habitat Protection also provides technical assistance to other regulatory programs like the Oil Spill Unit

and Solid and Hazardous Materials to help prevent and correct adverse impacts on the marine environment.

Another important aspect of this program is participation efforts to restore and manage the states estuaries, including the National Estuary program which is carried out in cooperation with other states, local governments and the U.S. Environmental Protection Agency. Estuary management programs are cooperative efforts to assess adverse environmental impacts to estuarine ecosystems and to formulate and implement management plans to restore and enhance estuarine water quality and ecosystem health. Areas included in these management programs are Long Island Sound, Peconic Bays, Hudson River, New York/New Jersey Harbor, and Long Island's south shore bays.

The Marine Habitat Protection program is also responsible for managing and inventorying the State's marine habitats. Ongoing activities include trend analysis of tidal wetland gains and losses since the Tidal Wetland Act was passed in 1974, which is conducted using a computer-based geographic information system; and a first time inventory and mapping of marine habitats of the Hudson River from the Tappan Zee bridge north to the Troy Dam. For more information contact the Bureau of Marine Resources online at: fwmarine@gw.dec.state.ny.us or Finfish Crustaceans (631) 444-0435; Marine Habitat Protection (631) 444-0455; Shellfisheries (631) 444-0475

The Chesapeake Bay Monitoring Program

In 1976, Congress directed the Environmental Protection Agency (EPA) to conduct a study of the Chesapeake Bay. Completed in 1983, the study found: bay grasses (submerged aquatic vegetation - SAV) had declined; oyster spat set had declined; landings of freshwater-spawning fish had decreased; levels of nutrients were increasing in many areas; the amount of summer Bay water showing low (or no) dissolved oxygen had increased significantly; high levels of heavy metals and toxic organic compounds had accumulated in Bay water and sediments.

Bay monitoring collects comprehensive data for a current description of the Bay. Collected over time, monitoring data may reveal trends.

The Chesapeake Bay Monitoring Program is a Bay-wide EPA/state cooperative effort. The program combines efforts of Maryland, Pennsylvania, Virginia, the District of Columbia, several federal agencies, 10 institutions, and over 30 scientists. Nineteen physical, chemical and biological characteristics including finfish and shellfish are monitored 20 times a year in the mainstem and many tributaries.

Since its inception in 1983, the Bay Program's highest priority has been the restoration of the Bay's living resources- its finfish, shellfish, bay grasses and other aquatic life and wildlife. Improvements include fisheries and habitat restoration, recovery of Bay grasses, and significant advances in estuarine science. For more information, contact the Chesapeake Bay Program Office: 410 Severn Avenue, Suite 109, Annapolis, MD 21403 / Tel: (800) YOUR-BAY / Fax: (410) 267-5777 or <http://www.chesapeakebay.net/monprgms.htm>

The Chesapeake Research Consortium

The Chesapeake Research Consortium (CRC) supports research, scientific and technical activities in the tidal Chesapeake Bay, its drainage basin and adjoining airshed, as well as adjacent offshore waters of the Middle Atlantic Bight. Member institutions includes The Johns Hopkins University, University System of Maryland; Smithsonian Institution, The College of William and Mary; The Academy of Natural Sciences; The Dominion University.

The CRC assembles teams of scientists and engineers to work with public-policy specialists to design and undertake multidisciplinary studies; suggests individuals or institutions appropriate for special research tasks; provides access to scientists, excellent laboratories, experienced technicians, computer capabilities, and research vessels on a scale large enough to attack complex Bay or system-wide problems; works with state, federal and private agencies and institutions in joint approaches to solving specific problems of both local and national concern; assists management agencies by producing new insights, assessing knowledge, conducting workshops and symposia, and contributing to educational programs.

Virginia Fishery Independent Seine and Trawl Surveys

The Virginia Institute of Marine Science (VIMS) has conducted annual trawl and seine surveys since 1955. The primary objective of the survey is to monitor trends in the abundance of juveniles in about twenty recreationally, commercially and ecologically important finfish and invertebrates. Since 1955, the trawl survey has sampled waters from the mouth of the Chesapeake Bay north to the freshwater interfaces of the James, York, and Rappahannock rivers. Samples from about 60 stations are collected every month. At each station, a 30-foot-wide shrimp trawl is towed for five minutes.

A seine survey for juvenile striped bass was initiated in 1967, but was briefly suspended between 1973 and 1980, due to lack of funding. An index of abundance has been calculated every year since 1980 and this is the second longest continuous striped bass index in the U.S. This data also includes other species of fish. Data for COLO was obtained and will be entered into NPSpecies. The Internet address for the Virginia Institute of Marine Sciences Fisheries Juvenile Abundance Monitoring Surveys is: <http://www.fisheries.vims.edu/trawlseine/vimspage.htm>

NOAA Chesapeake Bay Program Fisheries Data

The NOAA-National Marine Fisheries Division maintains a division office in Annapolis to better serve the Chesapeake Bay Region. As part of their services to the Bay Region the office maintains a web site providing a variety of Chesapeake Bay specific summaries of Recreational and Commercial fishery trends, stock assessment information as well as long term database of commercial and recreational fisheries landings for the bay. The Internet address for the NOAA Chesapeake Bay Program Fisheries Statistics Page is: <http://noaa.chesapeakebay.net/fisheries.htm>

Maryland Chesapeake Bay Program Long Term Benthic Monitoring Program

The state of Maryland, in cooperation with the US EPA Chesapeake Bay Program, has monitored benthic species abundance in the Maryland Chesapeake Bay mainstem and tributaries since July 1984. This monitoring effort began as an extension of the ongoing Power Plant monitoring studies in the state. The current program is designed to give comprehensive spatial

and temporal information on benthic conditions in the bay. The sampling parameters include water quality measurements, benthic fauna identification and counts, benthic fauna biomass determination, and sediment analysis. Sample collection is performed independently from the Maryland Plankton and water quality monitoring programs. The data collected as part of this program include detailed taxonomic identifications and counts of benthic species, determination of sample biomass, sediment analysis and hydrographic profiles.

Virginia Chesapeake Bay Benthic Monitoring Program

The state of Virginia, in cooperation with the US EPA Chesapeake Bay Program, has monitored benthic species abundance's in the Virginia Chesapeake Bay mainstem and tributaries since March 1985. The program is designed to give comprehensive spatial and temporal information on benthic biota. The sampling parameters include water quality measurements, benthic fauna identification, benthic fauna biomass determination, and sediment analysis. Sample collection is performed on a quarterly basis independent from the Virginia Plankton and Water Quality monitoring programs. Additionally in 1996, a Benthic Sediment Profile Images (SPI) and Image Analysis component was added to this monitoring program. The SPI data is composed of photographic images and image analysis of the vertical bottom sediment profiles.

Section VI. Fish Inventories

Table5-1. Fish Inventories of Assateague Island National Seashore

Type of Habitat	Year(s)	Bibliography
Bay	1961	Schwartz, Frank J. 1961. Fishes of Chincoteague and Sinepuxent Bays. Pages 384-408 in No Author. American Midland Naturalist.
Bay	1969	Wiley, Martin L., Hartman, Ronald. 1969. A preliminary report on the fishes found in the dredge areas of Chincoteague Bay. National Park Service?, Berlin, MD?.
Bay	1970	Wiley, Martin L., Chandler, John P., Hartman, Ronald. 1970. The finfish of Chincoteague Bay. Pages ? in No Author. Assateague ecological studies, part I: environmental information. Natural Resources Institute, University of Maryland.
Bay/Estuarine	1971	Cooper, John W. 1971. The fishes of Tom's Cove. National Park Service, Berlin, MD.
Estuarine	1972	Casey, James F. 1972. Maryland Estuarine Juvenile Finfish Survey.
Bay	1983	Casey, James F. 1983. Fishery resources of the coastal bays of Maryland. Pages 71-89 in Editor unknown. Conference on the Coastal Bays of Maryland and Virginia: Chincoteague, Sinepuxent, and Assawoman. Committee to Preserve Assateague, Inc.
Bay/estuarine	1990	Norcross, Brenda L., Hata, David. 1990. Seasonal composition of finfish in waters behind the Virginia barrier islands. Pages 441-461 p in Martin, James H. Biota of the Virginia Barrier Islands. Virginia Academy of Science, Richmond, VA.
Unknown	1992	Casey, James F., Raynie, Richard C. 1992. Field survey and data analysis of weakfish, (<i>Cynoscion regalis</i>), in Maryland waters. Department of Natural Resources, Tidewater Administration, Fisheries Technical Report Series No. 5, Annapolis, MD.
Ocean/coastal bay	1992	Casey, James F., Raynie, Richard C., Wesche, Alan E. 1992. Investigation of Maryland's Atlantic Ocean and coastal bay finfish stocks. Department of Natural Resources, Federal aid project No. F-50-R-1, Annapolis, MD.
Freshwater	1986	?Jesien, Roman V. 1986. Freshwater pond studies.
Marine	1970	Richards, C.E., Castagna, M. 1970. Marine fishes of Virginia's Eastern Shore (inlet and marsh, seaside waters). Pages 235-248 in No Author. Chesapeake Science.
Marine	1974	Pacheco, Anthony. 1974. Survey of Marine Sport Fishery at Ocean City.
Marine	1979	Chandler, Catherine. 1979. Recreational Surf Fishing Survey.

Table 5-2. Fish Inventories of Cape Cod National Seashore

<i>Type of Habitat</i>	<i>Year(s)</i>	<i>Bibliography</i>
<i>Estuarine</i>	<i>1984,85</i>	Marteinsdottir, Gudrun. 1987. Herring River Estuary: Fish Survey, July and September 1984. December 1985. Report Appendix 2, pp. 93-120. Pages ? in Roman, Charles T. An Evaluation of Alternatives for Estuarine Restoration Management: The Herring River Ecosystem (Cape Cod National Seashore). National Park Service Cooperative Research Unit, Center for Coastal and Environmental Studies, Rutgers - The State University of New Jersey, New Brunswick, NJ 08903.
<i>Estuarine</i>	<i>1989</i>	Heck, K.L. =Jr., Able, Kenneth W., Fahay, M.P., Roman, C.T. 1989. Fishes and Decapod Crustaceans of Cape Cod Eelgrass Meadows: Species Composition, Seasonal Abundance Patterns and Comparison with Unvegetated Substrates. Estuaries. 12 2: 59-65.
<i>Freshwater</i>	<i>1991</i>	Jones, K. 1991. Freshwater Fish Inventory, Cape Cod National Seashore. Cape Cod National Seashore, South Wellfleet, MA.
<i>Freshwater</i>	<i>2000</i>	Mather, Martha. 2001. Fish of CCNS Kettle Ponds (Not listed in NRBIB). University of Massachusetts.
<i>Saltwater</i>	<i>1990</i>	Jones, Kyle. 1990. Saltwater Fish Inventory, Cape Cod National Seashore.
<i>Unknown</i>	<i>Unknown</i>	Jones, Kyle. 1993. Faunal Inventories.

Table 5-3. Fish Inventories of Colonial National Historical Park

Location in Park	Year(s)	Bibliography
Back River, Jamestown Island	1991	Swihart, Gary L., Spells, Albert J. 1991. Fishery inventory and baseline water quality of the Back River system, Jamestown Island, Colonial National Historical Park, Virginia. U.S. Department of Interior, Fish and Wildlife Service, NPS Agreement Number 4000-1-0007, White Marsh, Virginia.
Jamestown Island	1991	Spells, Albert J., Rafkind, Charles D. 1991. Jamestown Island fisheries: a prelude to management actions. Pages ? in No Author. 1991 Highlights of Natural Resource Management. National Park Service, Yorktown, Virginia.
Jamestown Island	1991	Spells, Albert J., Swihart, Gary. 1991. Untitled: Fish species captured during USFWS fisheries study. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Office of Fisheries Assistance, White Marsh, Virginia.
Jamestown Island	1991	Lattin, A.S. 1992. USFWS fisheries study, Jamestown Island, fish sampling zones, spring/fall 1991. 22" x 34". National Park Service, Yorktown, VA.
Cheatham Annex	1994	Swihart, Gary L., Daniel, Louis B. 1994. Fishery inventory and baseline water quality collected at Cheatham Annex Naval Supply Center, Williamsburg, VA. U.S. Fish and Wildlife Service, Document number NOO18993PONO21, White Marsh, VA.
Wormley Pond	1994	Author unknown? (no author included in original record). 1994. Fishery survey at Wormley Pond. Office of Fishery Assistance, White Marsh, VA.
Throughout Park	1995	Odom, Michael C. 1995. A qualitative inventory of the fisheries resources and baseline water quality parameters in the tidal environment of the Colonial National Historical Park, Virginia. U.S. Fish and Wildlife Service, Charles City, VA.
Unknown	1996	Murdy, Edward O., Birdsong, Ray S., Musick, John A. 1996. Fishes of Chesapeake Bay. Smithsonian Institution Press, Washington, D.C.
Estuarine/Marine	1998	Odom, Michael C., Swihart, Gary L. 1998. A Qualitative Inventory of the Fisheries Resources and Baseline Water Quality Parameters in the Tidal Environment of the Colonial National Historical Park, Virginia. United States Fish and Wildlife Service, NPS Agreement Number 4000-1-0007, Charles City, VA.
Unknown	1987	Swihart, Gary, Spells, Albert J. 1987. Fish species composition in selected streams in Colonial National Historical Park. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Office of Fisheries Assistance, White Marsh, VA.
Unknown	1988	U.S. Fish and Wildlife Service. 1988. Fish species Composition in Selected Streams in Colonial National Historical Park, Yorktown, Virginia. Office of Fishery Assistance, White Marsh, Virginia.
Cheatham and Wormley Pond Drainages	1998	Hobson, Christopher S. 1998. A Natural Heritage Inventory of the Cheatham and Wormley Pond Drainages, Colonial National Historical Park. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Natural Heritage Technical Report 98-11, Richmond, VA.
Grafton Ponds Sinkhole Complex	1998	No Author. 1998. No Title. Pages ? in Roble, S.M. A Zoological Inventory of the Grafton Ponds Sinkhole Complex, York County, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.
Sinkholes of COLO	1999	No Author. 1999. No Title. Pages ? in Virginia Department of Conservation and Recreation, Division of Natural Heritage. A Biological Survey of the Coastal Plain Depression Ponds (Sinkholes) of Colonial National Historical Park, Yorktown, VA. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Table5- 4. Fish Inventories of Fire Island National Seashore

Location in Park or Habitat Type	Year(s)	Bibliography
Long Island	1901	Bean, T.H. 1901. Catalogue of the fishes of Long Island, with notes on their distribution, common names, habits, and rate of growth. Annual Report of the Forest, Fish and Game Commissioner of the State of New York 6(1900).
Shore Zone-Long Island	1939	Greeley, J.R. 1939. Fishes and habitat conditions of the shore zone, based upon the July and August seining investigations, pp. 72-92. in: A Biological Survey of the Salt Waters of Long Island 1938, Part II. Conservation Department, State University of New York, Albany, NY.
Shore Zone-Long Island	1965	Briggs, P.T. 1965. Sport fishery in the surf on the South Shore of Long Island from Jones Inlet to Shinnecock Inlet. New York Fish and Game Journal. Vol. 12 No. 1: p. 31-47.
Shore Zone-Long Island	1967	Schaefer, R.H. 1967. Species composition, size, and seasonal abundance of fish in the surf waters of Long Island. New York Fish and Game Journal 14:1-46. No Title.
Shore Zone-FIIS	1975	Briggs, P.T. 1975. Shore-zone fishes of the vicinity of Fire Island Inlet, Great South Bay, New York. New York Fish & Game Journal. Vol. 22 No. 1: p. 1-12.
Shore Zone, Sailor's Haven	2000-2001	EEA, Inc 2001. Finfish sampling in the near-shore waters at Sailor's Haven. Unpublished report of NPS.
Marine-Long Island	1939	New York State, Conservation Department. 1939. A biological survey of the salt waters of Long Island. 28th Annual Report, Supplement Parts 1 and 2, New York State, Conservation Department, Albany, NY. 284 pp.
Marine-Long Island	1949	Nichols, J.T. 1949. Marine fishes new to Long Island and adjacent waters. Marine Life, Occasional Papers 1:35-37. No Title.
Marine-Long Island	1965	Alperin, I.M., Schaefer, R.H. 1965. Marine fishes new or common to Long Island, New York. New York Fish and Game Journal. Vol. 12 No. 1: p. 1-16.
Marine-New York Bight	1982	Grosslein, M.D., Azarovitz, T.R. 1982. Fish distribution. Marine EcoSystems Analysis (MESA) Program, MESA New York Bight Atlas Monograph 15, New York Sea Grant Institute, Albany, NY. 182 pp.
Marine-New York Bight	1986	Suszkowski, D.J., Santoro, E.D. 1986. Marine monitoring in the New York Bight, pp. 760-763. in: Oceans '86. IEEE Service Center, Piscataway, NJ.
Marine-FIIS	1993	New York Sea Grant Institute. 1993. Marine Resources in the Vicinity of the Fire Island National Seashore. Final Report, NY.
Bay	1958	Poole, J.C. 1958. The fluke of Great South Bay. The Conservationist Information Leaflet, (D-12)-(D-13), New York State Conservation Department, Division of Conservation Education, Albany, NY. 2 pp.
Bay	1962	Poole, J.C. 1962. The fluke population of Great South Bay in relation to the sport fishery. New York Fish and Game Journal 9(2):94-117. No Title.
Bay	1962	Briggs, P.T. 1962. The sport fisheries of Great South Bay and vicinity. New York Fish and Game Journal. Vol. 9 No. 1: p. 1-36.
Bay	1965	Briggs, P.T. 1965. The sport fisheries for winter flounder in several bays of Long Island. New York Fish and Game Journal. Vol. 12 No. 1: p. 49-70.
Bay	1970	Briggs, P.T. 1970. Rare or uncommon fishes seined in Great South Bay, New York. New York Fish and Game Journal. Vol. 17: p. 53-54.
Bay	1972	Gaw, J.R. 1972. Seasonal variations in the fish populations of Great South Bay and the Connetquot River, Long Island, New York. Unpublished Master's Thesis No. 1419, Adelphi University, Garden City, NY. 50 pp.
Bay	1973	Schreiber, R.A. 1973. The fishes of Great South Bay. Unpublished M.S. Thesis, State University of New York, Stony Brook, NY. 199 pp.

****Also refer to Ecological and Faunal Inventory Tables for FIIS (Appendix ??)***

Table 5-5. Fish Inventories of Gateway National Recreation Area

Habitat Type	Location in Park	Year(s)	Bibliography
Bay	Sandy Hook	1922	Breder, C.M. Jr. 1922. The fishes of Sandy Hook Bay. <i>Zoologica</i> 11:329-351. No Title.
Bay	Sandy Hook	1961	Crocker, Robert. 1961. Check list of fishes from Sandy Hook Bay. 5 pp.
Bay	Sandy Hook	1961	Eisler, R. 1961. Key to the marine fishes of Sandy Hook Bay. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Sandy Hook Marine Laboratory (Bureau of Sport Fisheries and Wildlife), Highlands, NJ.
Bay	Sandy Hook	1971	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Sandy Hook Marine Laboratory. 1971. Review of aquatic resources and hydrographic characteristics of Raritan, Lower New York, and Sandy Hook Bays. Unpublished, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Highlands, NJ. 61 pp.
Bay	Sandy Hook	1971	Walford, L.A. 1971. Review of aquatic resources and hydrographic characteristics of Raritan, Lower New York, and Sandy Hook Bays. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Sandy Hook Marine Laboratory, Highlands, NJ. 80 pp.
Bay	Sandy Hook	1984	Wilk, Stuart J. 1984. Finfish resources of the Sandy Hook-Raritan-Lower Bay complex--A review of research findings. Pages pp. 25 - 32 in Pacheco, Anthony L. Raritan Bay, its multiple uses and abuses. Proceedings of the Walford Memorial Convocation. A workshop sponsored jointly by American Littoral Society, New Jersey Marine Sciences Consortium, and National Marine Fisheries Service, Sandy Hook Laboratory. Sandy Hook Laboratory Technical Series Report No. 30, Sandy Hook, NJ.
Bay	Sandy Hook	1985	Berg, David L., Levinton, Jeffrey. 1985. The biology of the Hudson-Raritan Estuary, with emphasis on fishes. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment, NOAA Technical Memorandum NOS OMA 16, Rockville, MD.
Bay	Jamaica Bay	1985	LaPosta, Dori. 1985. Preliminary report of Jamaica Bay fishing survey. National Park Service, Gateway National Recreation Area, NY.
Bay	Jamaica Bay	1986	Riepe, Don, Tanacredi, John T., Sperry, Thomas, Lane, Bruce, Scaglione, Ann, Stempler, Wayne. 1986. Finfish of Jamaica Bay. Gateway National Recreation Area, National Park Service, US Department of the Interior, Brooklyn, NY.
Bay	Jamaica Bay	1988	Riepe, Don, Tanacredi, John. 1988. In the shadow of the World Trade Center - Jamaica Bay, a significant coastal fishery. Underwater Naturalist, Bulletin of the American Littoral Society.

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Bay	Sandy Hook	1988	Woodhead, P.M.J., McCafferty, S.S., O'Hare, M.A. 1988. Assessments of the fish community of the Lower Hudson-Raritan estuary complex. Marine Science Research Center, State University of New York at Stony Brook, Stony Brook, NY.
Bay	Sandy Hook	1990	Anonymous. 1990. Fish from Sandy Hook Bay 1990. 4 pp.
Bay	Sandy Hook	1990	MacKenzie, Clyde L., Jr. 1990. History of the fisheries of Raritan Bay, New York and New Jersey. Marine Fisheries Review. 52 4: 1-45.
Bay	Jamaica Bay	1985-86; 1988-1989	Scaglione, E. Ann. 1991. Jamaica Bay fisheries survey, 1985 - 1986, 1988 - 1989. Division of Natural Resources and Compliance, Gateway National Recreation Area, National Park Service, United States Department of the Interior, NY.
Bay	Unknown	1992	Woodhead, P.M.J. 1992. Assessments of the fish community and fisheries resources of the Lower New York Bay area in relation to a program of sandmining proposed by New York State. Marine Science Research Center, State University of New York, Stony Brook, NY 11794-5000.
Marine	?Sandy Hook	1854	Baird, S.F. 1855. Report of the fishes of the New Jersey coast, as observed in the Summer of 1854, pp. 1-39. in: 9th Annual Report (1854), Smithsonian Institution, Washington, DC. No Title.
Unknown-Long Island	Unknown	1901	Bean, T.H. 1901. The fishes of Long Island, with notes on their distribution, common names, habits, and rate of growth. Annual Report of the Forest, Fish, and Game Commissioner of the State of New York 6(1900):375-478. No Title.
Marine	Unknown	1927	Nichols, J.T., Breder, C.M. Jr. 1927. The marine fishes of New York and southern New England. Zoologica 9(1):1-192. No Title.
Marine	?Sandy hook	1955	Younger, R.R., Zamos, J.E. 1955. New Jersey's marine sport fishery. Miscellaneous Report No.16, Division of Fish and Game, New Jersey Department of Conservation and Economic Development, Trenton, NJ. 19 pp.
Marine/Nearshore-Long Island	Unknown	1967	Schaefer, R.H. 1967. Species composition, size, and seasonal abundance of fish in the surf waters of Long Island. New York Fish and Game Journal 14:1-46. No Title.
Unknown/New York Bight	Unknown	1977	McHugh, J.L. 1977. Fisheries and fishery resources of the New York Bight. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NMFS Circular 401, Washington, DC.
Unknown/New York Bight	Unknown	Past	McHugh, J.L., Williams, A.D. 1976. Historical statistics of the fisheries of the New York Bight area. NYSSGP-RS-76-013, New York Sea Grant Institute, Albany, NY. 73 pp.
Unknown	Sandy Hook	1976	Wilk, S.J., Silverman, M.J. 1976. Summer benthic fish fauna of Sandy Hook, New Jersey. NOAA Technical Report No. NMFS-698, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, D.C. 16 pp.

Unknown/New York Bight	Unknown	1983	Pacheco, Anthony L. 1983. Final report. Seasonal occurrence of finfish and larger invertebrates at three sites in Lower New York Harbor, 1981-1982. N.Y. District Corps of Engineers, commissioned under support agreement NYD 82-88 (C), 26 Federal Plaza, New York, NY 10278.
Unknown	Sandy Hook	1990	Tanacredi, John T. 1990. Seining surveys at Sandy Hook Unit. Gateway National Recreation Area, Division of Natural Resources, N22(GATE-RM), NY.
Unknown	Unknown	1986-1994	U.S. Department of Interior, National Park Service, Gateway National Recreation Area. No Date. Fisheries surveys, 1986 - 1994. U.S. Department of Interior, National Park Service, Gateway National Recreation Area, Division of Professional Services, Brooklyn, NY.

Fish Inventory of George Washington Birthplace National Monument

Author unknown. 1994. Recreational fishery survey, George Washington Birthplace National Monument. National Park Service, Washington's Birthplace, VA.

Section VII. Monitoring Programs at C&B Parks

ASIS

Maryland Coastal Bays Environmental Monitoring Program(MCBP)

Maryland Department of Natural Resources is working with the MCBP to protect and restore Maryland's Coastal Bays. Part of the U.S. Environmental Protection Agency's National Estuary Program, the MCBP is a cooperative effort between local, state, federal governments and local citizens. The goals of the program are to carry out technically sound assessments of the health of Maryland's Coastal Bays and identify necessary modifications to current and future management efforts. Access the MCBP website at <http://www.mdcoastalbays.org>.

The DNR Fisheries Service has maintained a fish population monitoring project in the coastal bays since 1972. Fixed trawl sites are monitored monthly between April and October and 19 fixed seine sites are monitored in June and September including sites on ASIS.

The bays are sampled by trawl and seine from April through October, and all species collected are recorded. This data is used to track the abundance of many recreational and commercial fisheries, as well as for monitoring the community structure of the coastal bays. While the fish community of the bays has fluctuated over the past two decades, the observed changes provide little evidence for systematic declines in environmental quality. An Index of Biotic Integrity developed by Linder et. al. 1995 detected no trends in fish health over the last twenty years (species richness --the total number of species collected-- has actually increased). However, the data has shown an unexplained decline in a forage fish index (abundance index of spot, bay anchovy, Atlantic silverside and juvenile menhaden). Many possible factors can impact the forage species abundance including natural cycles, poor water quality, land use practices, over-harvesting, lack of food, predation, or decrease of suitable habitat.

Finfish Data Collection -

Fish species and abundance data at long term fixed stations is collected by DNR. Fish community structure (number of species and individuals), length and external condition (health) is monitored monthly (from April - Oct) using trawl and seines. Data analysis includes examining trends in the index scores over time and relationships with water quality. Historic DNR data will be used to further develop a fish 'eutrophication indicator'. The abundance of forage species may be used as a long term indicator for monitoring the fish community structure and overall health of the coastal bays. Fish data is managed as SAS datasets. This data for ASIS needs to be obtained for entry into NPSpecies.
http://www.dnr.state.md.us/coastalbays/mon_plan.html

FIIS

Species-Habitat Relationships

A thorough discussion of FIIS marine finfish is discussed in a 1993 New York Sea Grant/Cornell University document titled Estuarine Resources of the Fire Island National Seashore and Vicinity (Bokuniewicz, 1993). Major finfish studies of FIIS and their findings are discussed. In addition, ecologically and economically important species, species-habitat relationships, data gaps and monitoring needs, potential resource habitat issues and impacts as well as species list by habitat are given. Marine invertebrate resources of FIIS are also discussed in detail. This document will be extremely useful to a finfish expert who may be interested in recommending long-term monitoring programs at FIIS.

Monitoring Programs

Comprehensive Monitoring Study at Wm. Floyd Estate

Currently, a cooperative effort with USGS/USFWS/Moriches Bay Audubon Society at the Wm. Floyd Estate is underway to conduct annual surveys that include water tables, salinity levels, vegetation characteristics, invertebrate surveys including mosquitoes, waterfowl surveys and fish surveys. Data collection began in the Fall of 1999.

Benthic Animals

On Fire Island, Robert Cerrato is studying the effects of storms, off-road vehicle traffic, and seasonal environmental changes on the intertidal and supralittoral beach fauna. Also, he is interested in assessing the environmental effects of several alternatives proposed for the disposal of dredged material in New York Harbor. These alternatives include the construction of an island with dredged material and the construction and backfilling of pits in the seafloor. For more information contact: Robert M. Cerrato, Associate Professor; Yale University
rcerrato@notes.cc.sunysb.edu

GATE

The Harbor Estuary Program

The Harbor Estuary Program (HEP) is a National Estuary Program authorized in 1987 by the U.S. Environmental Protection Agency. The program is a multi-year effort to develop and implement a plan to protect, conserve, and restore the estuary. Participants in the program include representatives from local, state, and federal environmental agencies, scientists, citizens, business interests, environmentalists, and others.

The New York-New Jersey Harbor Estuary was designated and "Estuary of National Significance" in 1988 by the US Environmental Protection Agency, in response to a request by the two state Governors. The HEP was convened as a partnership of federal, state, and local governments; scientists; civic and environmental advocates; the fishing community; business and labor leaders; and educators (called the Management Conference). The mission of the Conference was to develop a plan to protect and restore the Estuary. In 1987, Congress also required the preparation of a restoration plan for the New York Bight, the ocean area extending

approximately 100 miles beyond Harbor waters. Because the Harbor and Bight are inextricably linked within the larger ecosystem, the two plans were joined.

Boundaries of HEP are the tidal waters of the Hudson-Raritan Estuary from Piermont Marsh in New York State to an imaginary line (the Sandy Hook-Rockaway Point Transect) connecting Sandy Hook, New Jersey, and Rockaway Point, New York, at the mouth of the Harbor. This area includes the bi-state waters of the Hudson River, Upper and Lower Bays, Arthur Kill, Kill van Kull, and Raritan Bay. In New York, the area includes the East and Harlem Rivers and Jamaica Bay (GATE) , and in New Jersey it includes the Hackensack, Passaic, Raritan, Shrewsbury, Navesink, and Rahway Rivers, and Newark and Sandy Hook Bays (GATE).

The **HEP/LISS Regional Data Index** is a searchable database of NY/NJ Harbor and LI Sound related *metadata* (detailed information describing data sets) intended to help you find the data you need. The information is contained in a Microsoft Access database and can be searched by defining applicable parameters using the menu choices here. The goal of the Regional Index is to provide a centralized, comprehensive database of environmental studies within the NJ/NJ Harbor area and Long Island Sound area with pointers to the actual data or contact person. Categories include habitat and living resources, monitoring, land use management, public participation and education, toxics, and water use. <http://www.harborestuary.org/regindex.htm>

HEP PUBLICATIONS include:

Comprehensive Conservation and Management Plan (CCMP) for the New York – New Jersey Harbor Estuary Program, March 1996 (280pp)

Summary of the Comprehensive Conservation & Management Plan, March 1996 (56pp).
Request a copy.

2001 Status Report: A Regional Model for Estuary and Multiple Watershed Management –
Report by the Habitat Workgroup of the HEP, April 2001 (188pp)
View at New Jersey Environmental Library

Harbor Health/Human Health: An Analysis of Environmental Indicators for the NY/NJ Harbor Estuary - Hudson River Foundation, March 2002 (40pp, 1,154k)

To obtain these documents go online to: <http://www.harborestuary.org/library.htm#pub/>

James J. Howard Marine Sciences Laboratory

The James J. Howard Marine Sciences Laboratory, located on the New Jersey shore Sandy Hook, is a state-of-the-art marine research facility shared by the National Oceanic and Atmospheric Administration (NOAA) and the State of New Jersey. Federal research at the laboratory is conducted by NOAA's National Marine Fisheries Service (NMFS). The Howard Marine Laboratory was preceded by NMFS' Sandy Hook Laboratory, which began operation at Fort Hancock in 1961. <http://sh.nefsc.noaa.gov>

The primary mission of the Howard Laboratory is to conduct research in ecology, leading to a better understanding of both coastal and estuarine organisms and the effects of human activities on nearshore marine populations.

Currently, The Ecosystem Processes Division, comprised of four branches, seeks to understand the effects of natural and human-induced environmental factors on fishery resources, and ultimately to predict the effects of variation in such factors on the composition, distribution, abundance, and production of fishery resources. An emphasis is placed on the study of reproductive activity and early life stages since these are generally the most vulnerable to environmental variation. Research is principally process-oriented, which includes both field and lab studies.

Coastal Ecology Branch

The Coastal Ecology Branch conducts field and laboratory studies on life habits and ecological requirements of economically important marine fishes and invertebrates to determine how they are affected by both natural processes and anthropogenic activities in the marine coastal environment. The Branch conducts research on the status of living marine resource populations, determining the relative functional value of specific habitats and how habitat loss and degradation, as well as mitigation or restoration of these alterations, affects productivity and diversity.

Current research includes determining effects of mobile fishing gears on habitat, and refining designations of essential fish habitat. The Branch leads the Environmental Processes Division's efforts to provide needed information to users such as the NMFS Northeast Regional Office and fishery management councils and commissions.

Marine Chemistry Branch

The Marine Chemistry Branch focuses on a wide range of research themes related to the health and well being of marine resource species, and the extent to which human activities affects fisheries sustainability and utilization. The Marine Chemistry Branch characterizes water, sediment, and tissues of a variety of fish and invertebrate species to determine how biogeochemical energy, carbon, elements and compounds are distributed in nearshore and estuarine systems, and how they are transferred through the food web. Chemical characterization by complimentary techniques address a variety of fisheries management issues concerning resource species, such as, stock identification, the functional utilization of habitat by fish, and the identification of critical habitats during their various life stages.

Functional Quality of Marine Fisheries Habitats

Promotion of sustainable fisheries requires an understanding of how habitat quality affects fisheries resources. This study continues to refine the hypothesis that variances in growth rates of estuarine dependent fish (as the response variable) are related to physical and chemical variables.

Continental/Estuarine Linkages

While estuaries are known to provide essential nursery habitats for many species of fish and

invertebrates, little is known about the role of coastal ocean areas on the inner continental shelf in providing habitats of similar value. The presence of an estuarine-oceanic frontal zone and associated estuarine-oceanic exchange of seston in the Inner New York Bight is suspected to be of considerable importance to settlement, survival and migration during the crucial first year of life for some species of estuarine fish. The objective of this multi-year project is to describe those processes and conditions aiding or inhibiting recruitment of young-of-the-year (YOY) fish of several important species to estuarine habitats in the vicinity of the Hudson River Plume frontal zone. Toward that end, thirteen sites including Jamaica Bay and Sandy Hook Bay are sampled monthly during spring, summer and fall to determine the distributions of larval and juvenile fishes, their food resources and potential predators, and the corresponding distributions of important environmental variables in water and sediment columns. During 1998-1999, biological sampling was performed by means of bottom trawls and plankton tows, while hydrographic conditions and processes were assessed via depth profiles of temperature, salinity and dissolved oxygen. The presence/absence of a number of species of fish in all life stages as a function of time and space will be interpreted in the context of hydrographic and benthic processes and environmental conditions.

The transport of particulate organic matter and the production of new organic matter within the Hudson River Plume is thought to be one of the processes controlling the productivity of fisheries resources in the New York Bight. In conjunction with particulate organic carbon and nitrogen data, the elemental composition of the particles in the Hudson River Plume will be interpreted in the context of sources from the Hudson, Raritan, and Shrewsbury Rivers, the Arthur Kill and resuspension of bottom sediments, and sinks to the sediments within Lower New York and Raritan Bays and advection to the New York Bight.

While physical measurements of fish in all life stages are performed, the YOY juveniles are also analyzed for lipids and proteins in order to determine biochemical condition, and to assess the use of this measurement as a means of rating habitat value. This biochemical measure of juveniles is expected to provide a means of characterizing the value of habitats directly in terms of the health and fitness of fishes to survive in the estuarine and coastal waters.

Behavioral Ecology Branch

The Behavioral Ecology Branch employs a multidisciplinary, experimental, and community-based approach to investigate mechanisms that affect recruitment, distribution, and abundance of economically significant marine fishes and invertebrates. The Branch conducts field and laboratory studies on habitat requirements and preferences, predator-prey relationships, movement and migration patterns, reproductive behavior, and other behavioral responses that influence populations of resource species. Emphasis is placed on interactions among managed species, their predators and prey, and environmental parameters such as sediments, macrophytes, water column characteristics, and hydrography. Both qualitative and quantitative aspects of the habitat are explored, and behavioral processes at all stages of animal development are considered. Research includes *Distributional Ecology and Recruitment of Demersal Fishes and Ecology of Estuarine Bluefish*.

Oceanography Branch

The Oceanography Branch analyzes data collected on the Northeast Continental Shelf ecosystem to understand how the components of the ecosystem influence the distribution, abundance, and productivity of living marine resources (LMRs). The Branch conducts process oriented research on the influence of the environment and lower trophic levels on LMRs. Specific focus is given to studying the physical and biological processes which control the growth and survival of the early life stages of fish populations and of their zooplankton prey organisms.

Hudson-Raritan Estuary Survey

Conducted by the James J. Howard Marine Sciences Laboratory from 1992-1996, the objectives of this survey were to:

- Provide a historical and timely baseline of fisheries independent data to measure natural as well as anthropogenic changes in fish distribution, abundance, ecology and life history.
- Provide a means of identifying and describing habitat requirements of selected species.
- Provide a statistically sound means of collecting synoptic physical, chemical and biological information.
- Provide a basis to design and conduct directed field experiments: e.g., before and after dredging, filling, etc.
- Provide a means to test laboratory experimental results and/or to identify parameters that can be tested in the laboratory.

The Hudson-Raritan estuary for study purposes was divided into three channel and six non-channel strata. Each strata was divided into sampling blocks. The resulting 217 blocks are approximately 0.5 nm square where possible. The 40 blocks to be sampled are selected randomly prior to each monthly research cruise. The number of blocks sampled in each strata is proportional to the area of each strata. Several of the strata sampled appeared to be located in close proximity to GATE lands including one strata inside Sandy Hook Bay and two strata along the coastline of the Staten Island Unit.

From the Research Vessel *Gloria Michelle*, fish and invertebrates were collected using a three quarter Yankee otter trawl. The trawl was towed for 10 minutes at 2 knots at each sampling location. The catch was brought aboard and sorted to species. Species were collectively weighted and individually measured for length. Any species not retained for other research were returned to the bay.

Results of this survey were:

- The Hudson-Raritan Estuary exhibits a very rich and diverse community of living marine resources characterized by the seasonal occurrence of 88 and 27 species of fish and large invertebrates, respectively.
- Distribution and abundance of fish and invertebrates vary from strata to strata, season to season, as well as year to year.

- The estuary is dynamic. No two years are the same, relative to the catch of species both in number and weight.

For graphs of the yearly and monthly mean catch per unit effort of the top fish and invertebrate species go online to: <http://sh.nefsc.noaa.gov/hudsrars.htm>.

Status and Trends

Decisions on the use and allocation of resources in the nations coastal and estuarine regions require reliable and continuous information on the status and trends of environmental quality in those areas. Beginning in 1984 the Ocean Assessments Division (OAD) of the James J. Howard Marine Sciences laboratory undertook the task of providing this information through its National Status and Trends (NS&T) Program for Marine Environmental Quality. The program's objectives include defining the geographic distribution of contaminant concentrations in biological tissues and in sediments, determining temporal changes in those concentrations, and documenting biological responses to contamination. (from NOAA Technical Memorandum NOS OMA 38 12/87). Two bay sites that are monitored include Western Long Island Sound (SAHI) and Raritan Bay (GATE)

GEWA

Currently, there are no fish NPS monitoring programs occurring at GEWA (pers. communication Rijk Morawe, GEWA Resource Manager)

SAHI

No known inventories of fish or monitoring programs for fish have occurred at SAHI.

THST

No known inventories of fish or monitoring programs for fish have occurred at THST (pers. communication ?Rijk Morawe, THST Resource Manager). However, the Maryland Biological Stream Survey (MBSS) was recently conducted on Hog Hole Run which is located at the western boundary of THST.

Maryland Biological Stream Survey (MBSS)

The MBSS was administered by the Maryland Department of Natural Resources. The MBSS is a statewide survey of first, second and third order streams designed to characterize current biological and habitat conditions and provide a basis for assessing future trends.

The study area for the MBSS includes each of the 18 major drainage basins of the state, and a total of three years was required to sample all 18 basins. Each basin was sampled at least once during the three-year cycle, and one basin in each region was sampled twice so that data collected in different years could be combined into a single statewide estimate for each of the variables of interest.

Fish and herpetofauna were sampled during the summer index period using quantitative, double-pass electrofishing of the 75 m stream segments. Blocking nets were placed at each end of the segment, and one or more direct-current, backpack electrofishing units were used to sample the entire segment. All fish captured during each electrofishing pass were identified, counted, weighed in aggregate, and up to 100 individuals of each species were examined for external anomalies such as lesions and tumors. All gamefish captured were also measured for length. Any amphibians, reptiles, freshwater molluscs, submerged aquatic vegetation either in or near the stream segment were collected and identified.

Data for the Lower Potomac River basin including Hog Run Hole, which borders the western edge of THST was compiled and is available in report format and online. Twelve fish species for Hog Run Hole were listed (Boward et.al. 1998). This data will be entered into NPSpecies as “probables”. To access this report go online to:
<http://www.dnr.state.md.us/streams/mbss/specific>

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